BARTH & ROGER'S
MANUAL
OF
AUSCULTATION & PERCUSSION

Henry Setchell

Hatcher

Hill

A MANUAL

OF

AUSCULTATION AND PERCUSSION,

BY

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TRANSLATED, WITH ADDITIONS,

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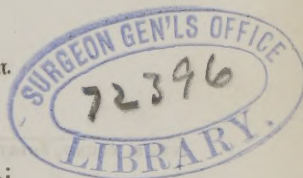
Second Edition.

PHILADELPHIA:

LINDSAY & BLAKISTON,

N. W. CORNER OF FOURTH AND CHESTNUT STREETS.

1849.

TO

Dr. Thomas Mackie Smith, of Delaware,

THIS LITTLE WORK

IS AFFECTIONATELY INSCRIBED,

IN GRATEFUL REMEMBRANCE OF MANY KINDNESSES,

BY HIS BROTHER AND PUPIL.

PREFACE.

This little work, which is respectfully offered to the practitioner and student, is a translation of the *Resumé* of the second edition of Barth and Roger's work on Auscultation, with the addition of a new treatise on Percussion, by the same authors, and such matter from the body of the work and other sources, as the translator thought might prove useful. The tables which are inserted, are modifications of those of Dr. Walshe, adapted to suit the text, and the whole is intended as a short manual of the most important diseases of the chest and abdomen, and their method of diagnosis by physical signs.

<div align="right">F. G. S.</div>

291 Spruce St.

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PREFACE TO THE SECOND EDITION.

A SECOND edition of this little work having been called for, the translator has endeavoured to correct many defects which had escaped him in the first, and to introduce such additional matter as might make it more useful to the student and practitioner. Its great merit being its compact form, care has been taken not to overburden it with additions, but to present it, as nearly as possible, in accordance with the plan of the authors, and with the existing state of the Science of Auscultation and Percussion.

291 Spruce St., April, 1849.

CONTENTS.

PART I.

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AUSCULTATION.

By the term Auscultation, is meant *the act of listening*, and it is termed *pulmonary, cardiac, abdominal, &c.*, according as it is applied to the lungs, heart, or abdomen.

Its direct object is the appreciation of certain sounds produced either by the movements of the organs themselves, contained in the different cavities mentioned, or else transmitted by these organs from others in their neighbourhood in which they are actually produced.

Before attempting to apply auscultation to the detection of morbid phenomena in the chest, the student should make himself perfectly familiar with those of the physiological or normal condition. To do this— he should select a healthy individual and apply his ear to the different regions of the thorax, and note carefully the peculiarities of sound occurring in each. It is, perhaps, better to commence with immediate auscultation; that is, the *direct* application of the ear itself to the walls of the chest; it is much easier, and

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seems to be a sort of initiatory step to the use of the stethoscope.

After having made himself acquainted with the healthy sound, he may proceed to the investigation of those occurring in disease, bearing in mind the following

GENERAL RULES.

There are some general rules necessary to be observed in auscultation, in order that its results may be at the same time more available and clearly recognised. Some of these relate to the patient, others to the physician.

Rules in relation to the patient.

A. The part to be ausculted should be bare, or covered by a thin, soft garment, in order that the stethoscope may be accurately applied without producing any friction, and that the sounds may be readily transmitted to the ear: thick clothing, and particularly that of woollen stuffs, prevents our hearing the respiratory murmurs at all, except in the case of children, in whom respiration is naturally very noisy, and silken stuffs are objectionable, from the rustling sound they produce. It is better to leave nothing upon the chest but the shirt, or to cover the thorax with a towel, which will prevent the patient taking cold.

B. The patient should be in a convenient position, varying according to the disease, and the region to be examined.

Rules to be observed by the practitioner.

A. The practitioner should generally place himself on the side he is about to examine; sometimes it is better to pass to the opposite side, to the right, for instance, in ausculting the sounds of the heart. Usually, he may explore both sides of the thoracic cavity without changing his position. In cases, however, where the results of his examination appear doubtful, he should place himself on the right and left, successively, and auscult. Whatever position he assumes, he should auscult the anterior region with one ear, and the posterior with the other, habituating himself early to use either indifferently.

B. Auscultation may be *immediate* or *mediate*, that is, it may be practised with the naked ear, or with the stethoscope. Laennec attached too much importance to the use of this instrument; the merit of auscultation does not reside in the stethoscope, and the instrument adds nothing to the excellence of the method. The results are identical, whether we study the acoustic phenomena which are taking place in the living subject, by the direct application of the ear, or by the interposition of a conducting body. It is not necessary to proscribe, or adopt, exclusively, either method; both have their advantages, and our choice should depend on many different circumstances.

The *ear* perceives sounds over a greater extent, because all the parts of the head which come into contact with the chest, then become conducting media. But immediate auscultation cannot be of constant and gene-

ral application. Feelings of delicacy would prevent
the physician placing his head upon the anterior parts
of the chest of the female. In some parts, as the ax-
illa, the supra- and sub-clavicular, and the supra-spi-
nous regions, the groin, &c., the ear is with difficulty
applied in an accurate manner, particularly in very
thin persons. In dirty persons, too, covered with
perspiration, &c., feelings of disgust would render im-
mediate auscultation almost impracticable; this incon-
venience disappears, in part, however, by placing a
towel between the ear and the thoracic walls.

With the *stethoscope*, besides that it is not always
at hand, the amount of the sounds heard is less; but,
it has the advantage of being applicable to parts
where the ear cannot be used without difficulty. It
circumscribes sounds better, and marks limits with more
precision: but the same end may be attained by a well-
trained ear.

Briefly; both *mediate* and *immediate* auscultation
have their advantages.

They should be employed alternately by the physi-
cian who seeks to establish the most accurate and com-
plete diagnosis, in order that he may prescribe the
most rational and efficacious treatment. The choice
to be made between the two will vary, 1*st*, *accord-
ing to individuals*.—The *stethoscope* is almost inap-
plicable to children, who are alarmed by it; it is pre-
ferable in women, but with men, its use is a matter
of indifference; 2*d*, *according to region*.—In the pos-
terior parts of the chest the *ear* is more accurately

applied to the walls; anteriorly, there is hardly a choice between them. Over depressed regions, the stethoscope is used almost exclusively; it alone is employed in the auscultation of certain organs, as the larynx, trachea, abdominal aorta, &c.; *3d, according to the nature of the sounds.*—In the detection of certain resonant phenomena, sometimes the stethoscope has the preference, sometimes, the ear; the former is more convenient in circumscribed alterations, as in pulmonary apoplexy, or cavities; the latter, in diseases whose extent is greater, as bronchitis or pleurisy.

The form of the stethoscope, and the wood of which it is made, are not of so much importance as Laennec believed; from the moment in which it is looked upon, not as an ear-trumpet, but as an instrument, which, in some cases, is more convenient than the ear itself, the better will it fulfil its object, and the more useful will it be. The original cylinder has been generally abandoned, and the stethoscopes of Louis or Piorry substituted for it.

These instruments consist of a hollow cylinder of cedar or ebony, from six to seven inches long, by one to two at its base, of a narrower diameter in the superior three-fourths, and terminating above by a round plate of ivory perpendicular to its axis, on which the ear may rest. This plate may be of the same wood as the tube, and the stethoscope thus constructed of a single piece, is that which we prefer.

This instrument has been subjected to numerous modifications: Piorry himself, wishing to perfect it,

substituted metal for wood, in order to diminish the dimensions of the cylinder; some have invented elbowed stethoscopes, to enable them to auscult patients in every position without disturbing them, and in case of necessity to auscult one's self.

Others have substituted a projecting extremity in place of the horizontal plate, to be introduced into the auditory canal.   M. Landouzy has proposed a stethoscope having numerous branches, to allow several to auscult at the same time.   All these seeming improvements, and many others, which we have passed over in silence, have more inconveniences than advantages, and we believe the stethoscope, above described, sufficient for all purposes.*

If the ear is preferred in ausculting, it should be accurately applied, in order that it may follow the movements of expansion and contraction of the thorax without friction of the surfaces in contact. If the stethoscope is employed, it should be held as a pen, and placed perpendicularly upon the region to be ausculted, taking as a resting point a uniform surface to which it should be accurately adapted; then holding it by the pectoral

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* Many persons prefer the flexible stethoscope, (which resembles the ordinary flexible ear trumpet,) from the fact that the expanded extremity can be readily applied to any part of the chest, without change in the position of the practitioner or the patient.   It also saves him the necessity of stooping over the patient.   It may be used in ausculting either the lungs or heart. The sounds, however, are more or less obstructed by it, and for general purposes it is, perhaps, inferior to the inflexible instrument.—(TR.)

end with the fingers, (which should remain immoveable,) the pavilion of the ear should be applied to the horizontal plate of the instrument: if the exterior air find its way, either between the skin and stethoscope, or between the latter and the ear, it will produce sounds which will mask those of the air-passages. Care should be taken to press moderately: too violent pressure, at the same time that it is prejudicial to the hearing, will be painful to the patient, and may increase some of the symptoms, such as dyspnœa, pain, &c., and sometimes may even alter the sonorous phenomena. We should never fail *to auscult both sides comparatively;* comparison alone can enable us to distinguish alterations otherwise hardly perceptible, and which might have escaped our notice. By giving us the healthy region as a type, it places in relief the slightest modification presented by the diseased points.

It is almost unnecessary to add, that the physician requires profound silence around him; that he should auscult for a sufficient time, and so collect his thoughts as to be completely isolated from the external world, thus concentrating them upon the pathological interpretation of the sounds which meet his ear. By exercise he may accustom himself, not only, not to hear sounds which are occurring around him, but even to select from amongst many morbid phenomena that on which his attention should be mainly fixed.

These precepts being known, let us place the student at the bed-side of a patient: What time shall he select for auscultation? where commence his examina-

tion, and how far conduct it? what precaution shall
he take, in order to arrive most quickly and surely
at an acquaintance with the acoustic phenomena? Fi-
nally, how judge most accurately of their value?

In general, it is proper to pass from the simple to
the compound, and, in the examination of physical
signs, it is well to commence with those whose appre-
ciation is easiest. Thus, in exploring the chest, it is
natural to examine first its conformation and move-
ments, and define accurately the degree of resonance
of its walls. In this manner he will enter upon aus-
cultation with the chance of losing less time in needless
research. He will proceed precisely as though the
patient were unable to reply to him: if, on the contra-
ry, he can obtain information from him, he must ga-
ther it previously, as it will assist him in his examina-
tion; it will prevent unnecessary fatigue in the applica-
tion of different physical methods, and conduct him
more directly to the object of his search, by desig-
nating the apparatus or portion of apparatus which he
ought first to explore. For instance, if he is about
to examine the chest, the seat of pain, when any ex-
ists, will indicate the side on which he may expect to
find acoustic phenomena.

Let us now suppose his ear applied to the left side of
the thorax; if he has but little experience, how shall
he judge of the nature of sounds heard? They may
take place in the œsophagus or stomach, in the circu-
latory system, or the organs of respiration; in the lat-
ter case, they may depend on resonance of the voice,

cough, or respiration alone. The signs furnished by
the voice and cough are so intimately connected with
the acts themselves, that they are easily recognised:
it remains, then, only to decide whether the sounds
belong to the air-passages, the heart, or the superior
part of the digestive tract. Those of the œsophagus
and stomach have a peculiar character, and are a spe-
cies of gurgling caused by the displacement of gas: to
distinguish, then, whether the phenomena belong to
circulation or respiration, he must examine whether
the sound occurs sixty or eighty times, or only from
sixteen to twenty times in a minute; the distinction
will generally be easy. But this phenomenon, whe-
ther the effect of the action of the heart or lung, may
only occur at intervals, and then this rule is no longer
applicable; under these circumstances, he should satis-
fy himself whether it is immediately dependent upon
the movements of respiration, or the heart, whether it
is synchronous with the expansion of the chest, or the
pulsations of the radial artery. If it be connected
with the act of respiration, he should examine in what
respect it differs from the normal respiratory murmur,
either in force, rhythm, or character, or whether it
constitutes one of those abnormal sounds known by the
name of rhonchi; whether the rhonchus is dry or hu-
mid, the bubbles manifest only in inspiration, or in
both inspiration and expiration, what is their size,
number, &c.

He will thus by degrees succeed in recognising the
sound he seeks; but as many rhonchi, the *sub-crepitant*,

for example, are manifest in a variety of diseases, the physician should not be satisfied to establish a definite diagnosis from a single acoustic fact; he should study their shades of difference, intensity, seat, and extent; he should seek further information from other stethoscopic phenomena, take into account the accompanying physical signs, the local and general functional symptoms, the circumstances under which morbid accidents are developed, their progress, and finally all the physiological and pathological conditions relating to the subject. It is only by the union and attentive comparison of these different elements, that he can establish the basis of a correct diagnosis.

DIVISION.

Auscultation may be applied to the *chest, neck, abdomen, head,* and *extremities.* In the four sections corresponding to this division, we will treat successively of the different physiological and morbid phenomena, furnished by the principal apparatus of the economy.—(B. & R.,) *Tr.*

CHAPTER I.

AUSCULTATION OF THE RESPIRATORY APPARATUS.

AUSCULTATION of the respiratory apparatus is practised upon the thorax, or the laryngo-tracheal tube; its object is to study three orders of phenomena, furnished by *the respiratory murmur, the voice, and the cough.*

PARTICULAR RULES FOR THE AUSCULTATION OF THE RESPIRATORY APPARATUS.

When we wish to examine the modifications of the respiratory sound, the patient should be placed in different positions, according to the parts of the thorax to be explored. In the examination of the *anterior part,* he may be either standing with his arms hanging by his side, or seated in a chair, or in bed; but the dorsal decubitus is preferable, as the chest is then more firmly fixed. In that of the *posterior part,* if the patient is standing, or seated on a chair, or, what is better, sitting up in bed, he should cross his arms and bend his head slightly forward. Sometimes, when very weak, he may lie either upon his face, or rather upon his side. In any case, the muscles should be moderately tense and the position of the body symmetrical; the shoulders should be of the same height, the

head held erect, or somewhat inclined, either before
or backwards; at other times it may be turned alter-
nately towards the right or left, always being careful
that the change be the same on both sides, and that a
precisely similar position be assumed.   In the exami-
nation of the *lateral parts*, the patient should lie on
the opposite side to that examined; or he may be di-
rected to clasp his hands over his head, retaining, in
other respects, the position before described.   In some
rare cases, he should be placed on his hands and knees,
as, for instance, when it is necessary to determine
whether a liquid in the pleura changes its position
with that of the patient.

The patient should breathe naturally, that is to say,
on the one hand, without exaggerated effort, or making
a noise with his mouth, and on the other, without re-
straining his breath, two extremes into which he is
apt to fall, either through fear, ignorance, or from
the idea that something extraordinary is demanded of
him.

The observer, also, that he may not be deceived by
a false appearance of either too strong or too feeble
respiration, should always be careful to remark the
precise natural condition of the respiration.   It is
sometimes necessary for the patient to hurry these
movements, or increase their fulness, in order that the
more rapid passage of air, or its more complete pene-
tration into the cells of the lung, may make manifest
the otherwise indistinct murmurs.   Many individuals
cannot breathe as they are directed; they must then

be told to cough during auscultation; each act will be preceded and followed by a full inspiration, during which the acoustic phenomena will be more striking. The same end is sometimes attained, by causing the patient to speak, or to read several sentences in succession. In children, also, it is very difficult to obtain a spontaneous exaggeration of the respiratory movements; in them cough will be much more easily provoked. But, except in these particular instances, which demand, so to speak, an exaggeration of respiration, we must endeavour to preserve as regular and natural a condition as possible, because violent efforts may increase the intensity of the pain, or alter the true character of the sounds.

The practitioner should choose the most comfortable position for himself; if he is in a constrained posture, it will be impossible for him to keep his ear accurately in contact with the different regions of the thorax; and if his head is too low, the afflux of blood to it will dull his sense of hearing.

The choice between the ear and the stethoscope will be decided by the considerations mentioned in the preceding *general rules.*

" Both sides of the chest must be submitted to precisely the same examination—conducted precisely in the same way—auscultation should never be considered complete until the entire chest has been examined ; it is often in some or other situation, where the symptoms would least have taught us to look for disease, that auscultation proves its existence. In acute affec-

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tions, auscultation should be repeated twice, at least, in the twenty-four hours."*—*Tr.*

ARTICLE I.

RESPIRATORY MURMUR.

1. *Normal Respiration.*

If the ear is applied to the chest of a healthy man during respiration, a gentle murmur is heard, analogous to that produced by a person in a quiet sleep, or heaving a deep sigh: this is the *natural respiratory sound*, or the *vesicular murmur*. It is composed of two different sounds, each soft and distinct, to the ear —that of *inspiration*, which is more intense and prolonged, and that of *expiration*.

The vesicular murmur is stronger in those parts which correspond to greater thickness of the lung, and it is rather more rude towards the root of the bronchial tubes.

Normal bronchial respiration—Is equal in corresponding points on both sides, and, in some persons, rather more intense at the summit of the right lung. It is more noisy when the respiration is deep and rapid, and its strength is likewise increased in children (*puerile respiration;*) it is, on the contrary, more feeble in many old persons. In general, it is more intense, in proportion as the chest is more ample, and its walls thinner.

* Walshe on Diseases o^f the Lungs, p. 46. 1843.

II. *Alterations of the Respiratory Murmur.*

These may be divided into four classes:—1. Alterations of *Intensity;* 2. of *Rhythm;* 3. of *Character;* 4. Alterations by *Abnormal Sounds*.

1. *Alterations of Intensity.*

Considered in this point of view, respiration may be *strong, feeble,* or *absent.*

A. *Strong or puerile respiration.*—This consists in a more intense vesicular murmur than in the normal condition, with the preservation of its soft and distinct character. It announces less a lesion of the pulmonary organs at the point where it is heard, than disease of a more or less distant portion, the healthy parts making up for the inaction of those affected.

B. *Feeble respiration.*—This is characterized by a diminution in the normal strength of the vesicular murmur, sometimes preserving its natural softness, at others, becoming more rude. It depends either upon the sound being transmitted less perfectly to the ear, or produced with less intensity.

In the first case, it may be owing to *pleuritic effusions,* to *thick false membranes* deposited upon the pleura, or to *tumours* which remove the lung from the walls of the chest. In the second, it may be caused by *pleurodynia; contraction of the larynx; partial obstruction of one or more of the bronchial ramifications* by a collection of mucus, or by a foreign body; *the contraction* of their calibre; or *the compression* of their walls by tumours. We meet with it also in *pul-*

monary emphysema, and in *the first stages of phthi-
sis*.

Of all the diseases which we have just enumerated,
and which reveal themselves frequently by feeble re-
spiration, *tubercles*, *pulmonary emphysema, and
liquid effusions into the cavity of the pleura*, being
by far the most common, (*bronchitis*, also a common
disease, being readily distinguished by its peculiar rhon-
chi,) the student, on discovering this sign, ought to fix
his attention upon these diseases almost exclusively. If
the *feebleness* of the *vesicular murmur* coincide with
increased resonance of the thorax, there is *emphysema*
present; if, with *dulness*, there are *tubercles*, or *pleu-
ritic effusions*. If the feeble respiration, accompanied
by dulness on percussion, is confined to the summit
of the lung, there are most probably *tubercles ;* if it
is *circumscribed*, at the lower portion, there is rather
pleuritic effusion ; if it exists at the top of both
lungs, there are almost certainly tubercles on both
sides; if at the base, there is a double pleurisy, or a
double hydrothorax.

C. *Absent respiration.*—We say that the respira-
tion is *absent* or *null*, when the ear, applied to the
chest, hears absolutely nothing; the vesicular murmur
is wanting, and is replaced by no sound: there is com-
plete silence.

Absent respiration depends on the same condition
of things as feeble respiration, and it announces, con-
sequently, the same diseases, with this difference, that
it indicates more *decided anatomical lesions*. But

the entire absence of the respiratory murmur being, in exceptional cases only, a symptom of emphysema and tubercles;—the diseases of the larynx manifesting themselves by peculiar phenomena,—and the obliteration of the bronchi, or their obstruction by foreign bodies, as well as pneumothorax without perforation, &c., being affections, rare in comparison with liquid effusions into the pleura—it follows, that *absent* respiration is a sign of very great value, and a common indication of these effusions; and as pleurisy is more frequently single, and hydrothorax double, it follows, that well marked absence of the respiratory murmur, on one side of the chest, announces almost with certainty a pleurisy with effusion.

2. *Alterations of Rhythm.*

Respiration altered in its rhythm may be *slow* (as from twelve to seven per minute,) as in many of the diseases of the cerebro-spinal apparatus; or *frequent*, (from thirty to eighty,) as in a great number of the thoracic or abdominal affections,—sometimes it is *jerking*, in *asthma, pleurodynia, incipient phthisis, chronic pleurisy with adhesions, &c.* Sometimes it is long, sometimes short; finally, there is sometimes a *prolonged expiration*, and then, the respiratory sound is almost always more rude.

Of these different alterations, the last is the only one of importance as a diagnostic sign. We may say that the prolonged expiration is a symptom of only *two* diseases: *pulmonary emphysema*, or *tubercles*,

in the first stage of their development. In some cases, it is the first, or only stethoscopic sign of phthisis.*

3. *Alterations of Character.*

A. *Harsh respiration.*—This presents variable degrees of intensity, hardness, and dryness, and these alterations may occur in both expiration and inspiration, or in one alone.

We meet with it in emphysema of the lungs, in incipient phthisis, in fact, in every case where there is pulmonary induration, (as melanosis, chronic pneumonia, &c.) Of all these diseases, roughness of the respiratory murmur occurs most frequently in emphysema and phthisis. If this roughness be joined to dryness,

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* The late Dr. Jackson of Boston, gave a different account of the physical cause of prolonged expiration, from that which has been introduced into the tables on auscultation. According to this writer, as long as the pulmonary tissue retains its flexibility and normal permeability, the respiratory sound is composed of that caused by the passage of the air through the bronchi, and *that* by its entrance into the pulmonary vesicles, and as the latter predominates, it alone is heard. But in proportion as tubercular infiltration takes place, the number of vesicles and the vesicular expansion diminishes, and the sound produced by the air in traversing the bronchi, remaining the same, it prevails more and more every day, and, finally, as that of the vesicles decreases, is alone perceived.

Now, if to this, we add the fact, that as the lungs become infiltrated and denser in structure, their power of conducting sound is increased at the same time that their contractility is diminished, we can see not only how the expiratory sound may be more distinctly heard, but also increased in length by the slow contraction of the lung.—*Tr.*

in connexion with prominence, and exaggerated resonance of the thorax, it indicates *pulmonary emphysema*. If it be accompanied with a prolonged sound of expiration, and confined to the summit of the chest, with resonance of the voice and dulness on percussion, we may readily diagnosticate the presence of crude tubercles.

B. *Bronchial or tubal respiration.*—(Bronchial or tubal blowing sound.) Bronchial respiration, which is distinguished by an increase in intensity and an elevation of tone, may be well imitated by blowing through the hand, rounded into the form of a tube, or through a stethoscope ; the greater the force and rapidity with which we blow, the more it resembles the tubal sound.

Bronchial respiration, when slightly marked, differs but little from harsh respiration, of which it is but the exaggeration. When it is well marked, it has a decidedly *tubal* quality, which serves to distinguish it from *cavernous* respiration, which has generally a peculiarly hollow character.

Bronchial respiration may be heard in a great many affections of the pleura, bronchi, and lungs especially —such as inflammatory hepatization, large accumulation of tubercular matter, extensive pulmonary apoplexies, &c., liquid effusions into the pleura, different tumours compressing the lung, and, lastly, the uniform dilatation of the bronchi, with induration of the surrounding tissue.

Of all these diseases, the most common are phthisis pulmonalis, pleurisy, and pneumonia. When bron-

chial respiration is slightly marked, confined to the summit of the thorax, and supervening in the course of a chronic affection, it may be attributed to the presence of crude tubercles in the parenchyma of the lungs. When the *souffle* is more intense, and shows itself in an acute affection of the chest, we must suspect either pleurisy or pneumonia; if it is proportioned neither to the intensity nor extent of the *dulness* of the thorax, it will rather be an indication of pleuritic effusion; if, on the contrary, it is intense, decidedly tubal, and perceived throughout the whole extent of the dulness, there is reason to believe the existence of pulmonary hepatization.

C. *Cavernous respiration.*—(*Cavernous souffle or blowing sound.*)—This resembles the sound produced by blowing into a hollow vessel: and may be imitated by breathing with violence into the two hands, disposed so as to form a cavity. Its common seat is at the summit of the chest. It announces either elliptical dilatation of a bronchus or the existence of a *cavity* properly so called. But from the rarity of dilatations of the bronchi, and pulmonary excavations following abscess, gangrene, &c., compared with the frequency of phthisis, we may conclude, that nine times out of ten, cavernous respiration will indicate a cavity resulting from the softening of tubercles.

D. *Amphoric respiration*—This is of a resonant and *metallic* quality, and may be very well imitated by blowing into a large empty pitcher, or into a decanter. It is accompanied nearly always by *metallic tinkling*.

When amphoric respiration is well marked, it indicates almost infallibly pneumothorax, with pulmonary fistula. When ill-defined, it may announce the same disease, but may also be the symptom of a large cavity which is nearly always tuberculous.

4. *Alterations by Abnormal Sounds.*

Abnormal sounds are of two kinds: *rhonchi* and *friction sounds.*

1. *Friction Sounds.*

Pleuritic friction sounds.—The two reflections of the pleura, which in the healthy state, glide silently one upon the other in the movements of the lungs, rub upon each other with a perceptible noise when certain pathological conditions occur. The *pleuritic friction sound*, which is very analogous to the rustling of parchment more or less dry, is ordinarily of a jerking character, and made up as it were of a number of successive cracklings. It presents varieties of rudeness and intensity, which have given rise to the division into soft or *grazing*, and hard or *scraping* friction sounds; when very decided, it is perceptible to the hand applied to the chest; sometimes the patient himself can perceive it.

In order that this sound may be produced, it is necessary that the pleuræ, or at least one of them, should present asperities, and glide one upon the other, in the movements of elevation and depression of the ribs: these rough points depend almost always on the presence of

false membranes deposited upon the surfaces of the pleuræ.

We meet the pleuritic friction sound in *pleurisy*, in occasional cases of *tubercles of the pleura* without adhesions, in some other organic alterations of this membrane, and very rarely in some varieties of pulmonary emphysema. But most frequently this phenomenon indicates a *pleurisy which is improving*. If it is heard exclusively at the summit of the chest, we may suspect tubercular pleurisy.

2. *Râles, Rhonchi, or Rattles.*

Râles are abnormal sounds, which, being formed by the movements of the air through the air-passages, mingle themselves with the respiratory murmur, and either obscure or entirely replace it. We divide them into two groups: one called *dry* or *vibrating*, because they consist of *varying tones;* the other *humid* or *bubbling*, because they are caused by bubbles of air *passing through a liquid*.

1. *Vibrating râles.*—Under this head are included the two principal varieties of *sonorous râles:* the *acute* or *sibilant*, and the *grave* or *deep-toned*. The first consists of a *whistling sound* more or less acute; the second is characterized by a deeper, musical sound, resembling the snoring of a person asleep, or the sound of a bass-viol string. Oftentimes they occur together, at others, they alternate, and one takes the place of the other. The *sonorous râle* may be heard in a great many diseases, such as *inflamma-*

tions or *catarrhs of the bronchi*, whether *acute* or *chronic, in pulmonary emphysema*, and in the *compression* of the air tubes by tumours obstructing their passage, all different morbid conditions, yet having one common element by which they may be recognised, viz.: the *momentary* or *permanent* contraction of one point or other of the air-passages.

In consequence of the frequency of *bronchial catarrhs*, and the comparative *in*frequency of the other morbid conditions, in which *sonorousness* or *sibilance* manifest themselves, the *sonorous râle* announces almost certainly an *inflammation* or *catarrhal* condition of the bronchi.*

2. *Bubbling* or *mucous râles.*—This division includes the *crepitant, sub-crepitant,* and *cavernous* râles.

A. *Crepitant râle.*—The *crepitant* or *vesicular* rhonchus gives to the ear the sensation of a *fine dry* crackling sound, analogous to that produced by the decrepitation of salt in a pan by gentle heat, or that occasioned by pressing a thin layer of healthy lung between the fingers.† These bubbles which are perceived *only* in inspiration, are very small, very numerous, of equal size, and rather dry. Their favourite seat is at the posterior and inferior part of the chest, on either side.

* It is likewise heard in asthma, in which the constricted condition of the bronchial tubes also gives rise to the same variety of rhonchus.—(*Tr.*)

† It is also well imitated by rubbing a lock of hair between the fore-finger and thumb, near to the ear.—(*Tr.*)

The *crepitant* râle is heard in *pneumonia*, in certain forms of *pulmonary congestion*, (in *œdema*) *and apoplexy of the lung.**

In consequence of the extreme frequency of inflammation of the lung, contrasted with the comparative rareness of œdema and apoplexy, the *crepitant rhonchus,* particularly when its characteristics are well defined, is almost a *pathognomic sign* of *pneumonia at the period of engorgement.*

B. *Sub-crepitant* râle—(mucous, humid and bronchial.)—The sub-crepitant râle may be justly compared to the sound which is produced by blowing with a pipe into soap-suds. The varying size of the bubbles has given rise to the distinction into fine medium, and large subcrepitant.

The *number* of bubbles and their characters are equally variable. This râle accompanies both *inspiration* and *expiration,* and its most common seat is the *inferior and posterior part of the chest on both sides.*

* The following ingenious account of the physical cause of this rhonchus has been given by Dr. E. A. Carr, of Canandaigua, N. Y., in the Amer. Jour. Med. Sciences, No. VIII., N. S.

The sound in question is described as resembling that produced by rubbing a lock of hair between the thumb and fore-finger when held near the ear, or that produced by the crackling of fine salt when thrown upon burning coals. Dr. Copland compares it to the crepitation produced by distending a piece of lung with air after it had been compressed; and thinks it arises from the diminished calibre of the minute bronchi, owing to interstitial effusion, and admixture of respired air, with the secreted or effused fluids in the tubes and air cells. It is generally

The *sub-crepitant râle* may be recognised in a great number of diseases, such as *bronchitis in the second stage*, the different varieties of *catarrh* of the

supposed by auscultators, that this sound is caused by the bursting of extremely small bubbles of mucus in the air vesicles and smallest bronchi. Indeed, the later writers upon this subject class it among what they denominate *bullar râles*, and M. Raciborski, in particular, makes it depend on the crackling of the bursting bubbles, occasioned by the dry and viscid state of the mucus of which they are composed. M. Beau, who has made some very interesting and valuable observations on auscultation, dissents from the opinion commonly entertained respecting the *cause* of this sound, and suggests, whether, if we consider that it is not at all modified after a fit of coughing, and also that it is distinctly perceptible in many cases of pneumonia before any expectoration takes place, it does not more probably depend on *the friction of the pulmonary vesicles*, which like the pleura, pericardium, and synovial membranes, are probably somewhat dried (dessechées) by the existing inflammatory action.

Admitting that the considerations adduced by M. Beau appear to constitute a sound objection to the commonly received opinion on this subject, we may still be allowed to inquire if the views which he has offered as a substitute are not equally unsatisfactory.

If the sound in question were produced by the bursting of minute bubbles of mucus, it ought, like the mucous, and sub-mucous râles, to continue through *expiration*, since it is here that the bullar râles are *most* distinct. But every practical auscultator is aware, that while the râle crepitant continues uniform quite to the end of *inspiration*, it is suddenly and entirely suspended at the commencement of *expiration*.

That the bullar râles should be heard *most distinctly* during *expiration*, will appear very obvious when we consider the admirable arrangement provided for clearing the air passages of the bronchial secretion, and preventing them, as well as all foreign matters inhaled, from gravitating towards the air vesicles.

4

pulmonary mucous membranes, *dilatation* of the
bronchi with *excessive secretion*, certain forms of
congestion and *pulmonary apoplexy*, and *phthisis*

From the experiments of Sir C. Bell, and others, it is evident
that the transverse bronchial muscles act in opposition to the
elasticity of the cartilaginous rings which enter into the forma-
tion of the bronchial tubes, and that during *inspiration*, these mus-
cles are relaxed so as to allow the air passages to expand to their
full extent. The effect of this simple arrangement is to allow
the air a free passage to the air vesicles, without disturbing the mu-
cus with which these passages are lubricated, but during expira-
tion these muscles are called into action, the calibre of the tubes is
diminished, the air is consequently expelled with greater violence,
the secretions occupying a greater proportion of the calibre of the
tubes are pushed forward till they accumulate in the larynx,
causing sufficient irritation to provoke a powerful expulsive ef-
fort, or cough, and are thrown off. Where the secretions are
abundant, as in the *later* stages of pneumonia and bronchitis, the
free passage of the air is partially obstructed, and the more espe-
cially during *expiration*, when the tubes are most contracted.
These secretions are consequently thrown into agitation, the air
mingling with them, forms numerous bubbles, the bursting of
which gives rise to the louder bullar râles.

But a very different state of things exists in the *early stage* of
pneumonia, where the crepitant râle is heard.

I believe M. Beau and Dr. Williams are quite correct in sup-
posing that the bronchial membranes are somewhat dried by
the existing inflammatory action, since one of the most manifest
changes, observed during the early stages of pneumonia, is a sus-
pension of the aqueous exhalation from the bronchial membranes.
Now, the suspension of this function necessarily leaves the mu-
cus with which the air passages are lubricated in so thick and
tenacious a condition, that these membranes are glued together
whenever they come in contact. The pulmonary tissue being
more or less compressed by the descent of the ribs, and the rising
of the diaphragm during *expiration*, the bronchial membranes are
to a greater or less extent forced into direct contact. The ca-

at the commencement of the softening of the tubercles. The most frequent of all these affections are *bronchitis* and *tubercles in the commencement of the stage of softening :* the presence of the *sub-crepitant râle*

pillary congestion and insterstitial effusion, which are among the essential elements of pneumonia, must greatly increase the volume of the diseased lung, and consequently augment the compression of the pulmonary tissue, and facilitate the adhesion or gluing together of the bronchial vesicles.

Now, during every *inspiration* the air rushing into and distending these vesicles, necessarily overcomes these cohesions, and would not the separating of these membranes thus glued together by tenacious mucus, naturally produce precisely such sounds, as constitute the crepitant râle of pneumonia? If this view of the phenomena be correct, it is not strange, that "distending a piece of lung with air after it has been compressed" should give rise to a similar râle.

A great variety of experiments might be here introduced to illustrate this view of the phenomena. One of the most simple is that of moistening the thumb and finger with very thick paste, or mucilage of gum Arabic, and alternately pinching them together, and separating them when held near the ear. By repeating and modifying this simple experiment, sounds may be produced so perfectly imitating the crepitant râle of pneumonia, that I am persuaded no one who will take the trouble to try it will doubt this explanation of its cause. (According to Dr. Walshe, the phenomenon in question occurs in the parenchyma of the lung itself, especially in those portions of it immediately contiguous to, and actually forming the walls of the ultimate terminations of the bronchi, and its physical cause is the sudden and forcible expansion of that parenchyma glued together, as it were, by the viscid exudation with which it is infiltrated. But, as is justly remarked by Dr. Stillé,* as it is difficult to conceive how such a process could generate sound where no air exists, and as it is well known that the crepitant soon emerges into the sub-crepitant, which all admit takes place in the minute bronchi, we

* Elements of General Pathology, by Alfred Stillé, M. D., &c., &c.

ought to lead us to suspect the existence of these two
diseases particularly, and the knowledge of the favour-
ite seat of the rhonchus will guide us in our diagnosis.
If the bubbles are very numerous at the base of the
lungs, and diminish in proportion as the ear of the ob-
server approaches the top of the chest, the existence
of *bronchitis* is almost certain; if, on the contrary,
they are absent, or very few in number at the base of
the thorax, and are heard higher up, particularly on
one side, becoming more and more numerous as the
auscultator rises, *we ought to diagnosticate tuber-
cles in a state of softening*.

C. *Cavernous râle*, (gurgling.)—This râle is caused
by bubbles, less numerous, large, irregular in size, and
joined with cavernous respiration; it is this *mix-
ture* which gives it its *distinctive character*.   It is
perceived both in inspiration and expiration, and is
ordinarily confined to the summit of one or both lungs.
Sometimes the rhonchus, although situated at the
upper part of the chest, has smaller bubbles and a
clearer tone, without any admixture of cavernous re-
spiration: this is the *cavernulous râle*.

The *cavernous rhonchus* announces either the pre-
sence of a *cavity in the lung*, communicating with
the bronchi, or an elliptical dilatation of the bronchi.
If it is accompanied by the *cavernous voice*, and has

fully adopt the opinion of Dr. Carr,—that the crepitant rhonchus
is formed in the vesicles themselves.)—TR.

The same explanation of the physical cause of this râle had
also been given by Professor Mitchell, of the Jefferson Medical
College, some time previously to the appearance of Dr. Carr's
article.—(TR.)

its seat at the summit of the lung, it will be an almost certain indication of the existence of a *tubercular cavity.*

Appendix.

There are still some *abnormal sounds*, not so well characterized however, more rarely recognised, and whose value has been determined with less precision: these are *cracklings, plaintive tones,* or at times something analogous *to the dull flapping of a valve;* at other times may be heard a *rustling sound,* (Fournet.) These phenomena have appeared to us to be due to the presence of *tubercular excavations,* with the exception of the rustling and crackling sounds, which we meet with only in the commencement of *pulmonary phthisis.*

ARTICLE II.

AUSCULTATION OF THE VOICE.

When we auscult the larynx of a man while he is speaking, the vocal sound is transmitted with distinctness through the stethoscope, and strikes forcibly upon the ear. Along the trachea this resonance is rather less grave and intense, and over the chest we hear only a confused humming sound. The *natural resonance* of the voice, which represents exactly all the varieties of the voice itself, is the more intense, in proportion as the latter is stronger and more sonorous, as

we listen nearer the great bronchial tubes, and as the chest is more ample and the walls thinner. It is equal in corresponding points on both sides of the chest, but is rather more marked towards the top of the right lung, on account of the greater diameter of the principal bronchus.

In the *pathological condition* sometimes the vocal resonance is only *exaggerated*, at others, it undergoes, in addition, modifications of its nature, and the voice becomes *bronchial, tremulous, cavernous*, or *amphoric*.

A. *Exaggerated resonance of the voice*, or *slight bronchophony*, is characterized by a rather stronger resonance of the voice than natural, not, however, to the extent of the *bronchial voice*, (true bronchophony.) It usually accompanies similar, but less marked and less extensive alterations.

B. The *bronchial voice* or *bronchophony* is a much stronger resonance than the natural; it is remarkable for its intensity, its extent, its fixedness, and its permanence. It usually accompanies bronchial respiration.

We may meet with it in *dilatation of the bronchi*, in *pleurisy*, and particularly in *induration of the lungs*. But in consequence of the infrequency of *dilatation of the bronchi*, it is almost always *pulmonary induration* that is determined by the presence of bronchophony; but, of all the diseases in which the density of the lung is increased, *pneumonia* and *tubercles* are by far the most common. The conditions essential to the production of bronchophony being more

complete in *pneumonia* than in *tubercles*, it is better
marked in the first disease than in the second; it only
exists in *some cases* of *pleurisy*, and if then it is de-
cided and extended, we may suspect that the pleuritic
effusion is complicated with *pneumonia* or *tubercular
induration*.

C. The *tremulous or bleating voice*,(ægophony,)
is a peculiar vocal resonance which assumes a shriller
tone and becomes trembling and jerking. It sounds
as if the patient were speaking with a counter placed
between his teeth and lips, (resembling the voice of the
puppet Punch.) It is heard generally on one side, in
the lower half of the sub-spinal space, and when it
occupies a more extensive surface, it is still most
strongly marked in this point; it may change its po-
sition in the different postures of the patient. It coin-
cides almost always with weakness or absence of the
vesicular murmur at the base of the chest.

True ægophony announces a pleuritic effusion,
which is, in nearly every case serous. If it is perceived
on one side only, accompanied by fever, there is pleu-
risy; if on both sides, without fever, and with general
dropsy, there is a hydrothorax. If it appears in the
course of an inflammation of the pulmonary parenchy-
ma, and more particularly if it changes its position with
that of the patient, it indicates a pleuro-pneumonia.

D. *Cavernous voice.* (Pectoriloquy.) We call
that a *cavernous voice*, in which the vocal vibra-
tions seem concentrated into a hollow space, whose
walls reflect them back to the ear, more or less dis-

tinctly articulated.—It is in general confined to the upper part of the chest, and coincides either with the *cavernous râle*, or more frequently with *cavernous respiration*.

The *cavernous voice*, like the *cavernous souffle*, indicates the existence of an elliptical dilatation of the bronchi, or a tubercular, purulent, apoplectic, or gangrenous excavation. From the rareness of these elliptical bronchial dilatations and pulmonary excavations, independent of phthisis, compared with the frequency of cavities in phthisical subjects, we may conclude that, nine times out of ten, *cavernous voice* indicates a tubercular excavation.

E. *Amphoric voice* is characterized by a resonance very much resembling the metallic and cavernous humming produced by speaking across the mouth of a large pitcher three-fourths empty.—It occurs usually with *amphoric respiration*, and like it, announces pneumothorax, or, more rarely, a large pulmonary cavity.

(In connexion with the auscultation of the voice may be mentioned another sign recently described by M. Monneret, and regarded by him as a valuable diagnostic sign of disease; it is the oscillation of the thoracic walls produced when a person either sings or speaks aloud, and is called by him *Thoracic vibration*. The following description and application of this sign is taken from the London Medical Times, and is a translation of the original article which appeared in the *Revue Med. Chirurgicale*, Sept. and Oct. 1848.

Thoracic Vibration.

By the term thoracic vibration, M. M. designates the oscillation of the parietes of the chest, perceptible by the application of the hand upon the thorax of a person who sings or speaks aloud. The vibrations are more distinct on the right side than on the left, and in the anterior than in the posterior regions. The vibration is propagated from the larynx, by the walls of the air-tubes, by the solid elements of the thoracic parietes, and by the air contained in the lungs. The larynx is the sonorous instrument, and the phenomena perceptible by the application of the hand, are caused by the propagation of the undulations of sound, through the agency of good conductors. By disease of the chest, the physical conditions of these conductors being modified, the pectoral vibrations undergo changes, which Dr. M. has studied for the purpose of discriminating from each other the various alterations of the respiratory organs.

The vibration is increased in pneumonia, and the first stage of consumption; it is diminished in pleurisy, emphysema, and pulmonary excavations.

In pneumonia thoracic vibration is invariably increased, and to that degree, that even when the signs furnished by auscultation and percussion are still of a doubtful nature, a positive diagnosis may be obtained, —a circumstance peculiarly advantageous in the diseases of infancy, when auscultation is difficult, and its results questionable. The phenomena of vibration are also increased in pulmonary œdema,—a fact testified in the last stages of disorders of the heart. In the first period of consumption, when the lung is condensed by

the presence of crude tubercular masses, it often happens that auscultation furnishes only negative signs, or increased roughness of the respiratory murmur, so slight as to leave some hesitation in the mind of the observer. In such cases, says Dr. M., the diagnosis is powerfully assisted by the application of the hand, while the patient speaks aloud—the vibration being invariably increased in the diseased regions. Again, in pleurisy, attended with the formation of plastic adhesions and false membranes, no fluid being exuded between the lung and the thoracic walls, the vibration caused by the voice is considerably augmented.

It is, on the contrary, diminished or abolished in pleurisy, when liquid effusion has taken place. The increase or diminution of the morbid secretion is also marked by corresponding modifications in the transmission of sound to the hand. In pulmonary excavations of some extent, the vibration of voice is decreased or altogether abolished; but, on the margin of the cavities, it is on the contrary increased by the condensation of the lung around the ulceration. In pneumothorax, Dr. M. had four times occasion to study the vibrations of the walls of the chest, and in all the cases he found them abolished in the regions corresponding to those occupied by the effusion of air. In pulmonary emphysema, also, the undulations of sound perceptible to the hand are diminished;—a fact easily accounted for by the rarefaction of the tissue of the lungs.

Thus, the study of the vibration of the thoracic walls can be made available in the diagnosis of doubtful

cases, and forms a valuable addition to the other physical signs of thoracic disease.—Tr.)

ARTICLE III.

AUSCULTATION OF THE COUGH.

When the ear is applied to the chest of a healthy man while he is coughing, we perceive a dull and confused sound, accompanied by a succussion which shakes the pectoral cavity. This phenomenon, composed of impulsion and sound, is the more perceptible as it occurs nearer the ear, in the large bronchial tubes, or as the patient coughs with greater or less violence. When we auscult over the larynx and the trachea, and, in an individual with a narrow chest, at the root of the bronchi, the cough has a cavernous character and produces the sensation of the rapid passage of air through a tube.

In the pathological condition, the cough presents special characters: it is *bronchial, tubal, cavernous,* or *amphoric.*

When the cough is *tubal,* the ear experiences the sensation produced by a column of air passing with much noise, violence, and rapidity, through a tube having solid walls. It manifests itself under the same circumstances as bronchial respiration, and is a decided symptom of *pulmonary hepatization.*

The *cavernous cough* consists in a stronger and much hollower resonance than the normal. It is accompanied by an impulse against the ear which is quite

distinctive. *It is one of the most positive signs of the existence of a cavity in the lungs.*

The *amphoric cough* is characterized by a well marked metallic resonance; when heard in connexion with the amphoric respiration and voice, it announces the existence of a *pneumo-hydrothorax*, or a *large pulmonary cavity*.

Metallic Tinkling.

We give this name to a slight silvery sound, single or multiple, resembling the sound produced by pouring grains of sand into a large metallic vessel. It accompanies both respiration and voice, but is generally more manifest during cough.

It announces the existence, either of a *very large pulmonary cavity*, a *pneumothorax*, or *hydro-pneumothorax*, with or without *fistulous perforation of the bronchi*.

In consequence, however, of the rareness of cavities sufficiently large to give rise to a perceptible metallic tinkling, this phenomenon, when well marked, is almost always indicative of pneumothorax. As gaseous effusions of the pleura rarely exist without a collection of fluid or pulmonary perforation, if the tinkling be produced in a constant and evident manner, both by respiration and voice, it is almost a pathognomonic sign of *hydro-pneumothorax*, with fistulous communication of the pleura and bronchi.

Thoracic Fluctuation.

In the physiological condition, succussion does not produce any sound in the chest; but when there is an

effusion of liquid and air into the cavity of the pleura, the collision of these fluids, produced by succussion of the trunk, or the spontaneous movements of the patient, causes the ear to perceive a plashing sound, exactly like that produced by shaking a decanter half filled with water; this phenomenon is sometimes so well marked, that it may be heard at some distance from the patient: it nearly always accompanies *amphoric respiration* and *metallic tinkling*, and like them, indicates the existence of *pneumo-hydrothorax*, or *a very large pulmonary cavity half filled with liquid*.

ARTICLE IV.

AUSCULTATION OF THE LARYNX.

In the *healthy condition* of the *larynx*, the respiratory sound has a *hollow* and *cavernous* tone, the *vocal resonance* is at its maximum, and the *cough* gives the sensation of the rapid passage of air through a hollow space. In the *pathological condition*, the laryngeal *respiratory murmur* is harsher, or more rasping, as, for instance, in *acute* or *chronic laryngitis;* or else it is replaced by a *whistling sound*, as in *spasm* or *œdema of the glottis*, in *stridulous laryngitis*, in some cases of *foreign bodies* in, and *compression* of the trachea; or by a *sonorous* tone, as in the cases of *laryngeal ulceration* with thickened edges, and obstruction to the passage of the air; or again, by a *snoring sound*, as in *simple* or *stridulous laryngitis*

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ulcerations, laryngeal vegetations, &c.,—a *sound* which has frequently a *metallic tone* in *croup*.

In some circumstances, the ear perceives a *laryngeal cavernous râle*, as, for example, when the trachea and larynx are filled with mucus, this râle may be more circumscribed and confine itself to the presence of the mucus upon an *ulceration*, or around a *foreign body* arrested in the ventricles, &c. Finally, in some rare cases, we hear *a tremulous* or *vibrating sound*, which announces the existence of *croup with floating false membranes*. There is another sign, that is met with in a great many diseases of the larynx, that may be established, it is true, by auscultation of the chest, but which ought to be mentioned here : it is the *diminution*, or *complete obliteration* of the *vesicular murmur*. This phenomenon accompanies every alteration which offers an evident obstacle to the introduction of air into the air passages, whether it *obstruct* or *narrow* the diameter of the tubes, (as swelling, inflammation, vegetations, accidental products, foreign bodies, &c.,) whether it compresses them from without, (cancerous tumours, cysts, aneurisms, &c.,) or whether, finally, it produces more or less complete occlusion of the superior orifice of the air tube, (as hypertrophy of the tonsils, polypi of the nasal fossæ falling upon the superior part of the larynx, &c.)

END OF AUSCULTATION OF THE RESPIRATORY APPARATUS.

TABLES.

TABLES EXHIBITING THE PHYSICAL CAUSE AND ORDINARY SEAT OF THE DIFFERENT PHYSICAL SIGNS, TOGETHER WITH THE NAMES OF THE DISEASES IN WHICH THEY ARE OBSERVED.

These Tables have been considerably modified from the original of Dr. Walshe, not with the hope of improving them, but in order to adapt them to the text of MM. BARTH and ROGER.

In the article, *Prolonged Expiration*, the physical cause has been given in the words of the Authors, as explained by them in the body of the work. In the *text*, a different explanation has been offered in a note by the Translator.— *Tr.*

Name of the Sign.	Physical Cause of the Sign.	Ordinary seat of the Sign.	Diseases in which it is observed.
Respiratory murmur.	Passage of air into the minute air vesicles.	Vesicular structure.	In health, "is a gentle sighing sound, soft, neither dry nor liquid, gradually developed, composed of two sounds, the inspiratory and expiratory, inappreciably separated." (Williams and Clymer.)
Strong or puerile respiration.	Increased rapidity of the passage of air into the lungs. It announces less, a lesion of the pulmonary organ at the point where it is heard, than disease of a more or less distant portion. The healthy parts making up for those affected.	Variable, may occupy a part or the whole of either side.	1. In healthy tissue, adjoining parts. { Obstructed by bronchitis. Foreign body in the principal bronchus. Condensed by tubercle. Apoplectic effusion. Pneumonia. Pleuritic effusion. Intra-thoracic tumours. Chronic consolidation. Rarefied by vesicular emphysema. } 2. In healthy tissue, suddenly released from spasm. } Spasmodic asthma. 3. In tissue affected with { Hypertrophy. Earliest stage of pneumonia.—(Walshe.)
Feeble respiration.	Obstruction to the entrance of air.	Variable, may occupy part of, or an entire lung.	Pleuritic effusions. Thick false membranes deposited on the pleura. Tumours which remove the lung from the

			walls of the chest. Pleurodynia. Contraction of the larynx. Partial obstruction of one or more of the bronchial ramifications. Contraction of their cavity, or compression of their walls by tumours. Pulmonary emphysema, and in the first stage of phthisis. Spasmodic asthma. More or less occlusion of the superior orifice of the laryngeal tube by hypertrophy of the tonsils. Polypi of the nasal fossæ, falling upon the upper part of the larynx.
Absent or suppressed respiration.	Complete obstruction to the entrance of air, or the interposition of a fluid preventing the transmission of the sound.	Variable, the part or whole of a lung.	Same diseases as *weak respiration*, with this difference, that it indicates more decided anatomical lesions.
Slow respiration.	Retarded action of the respiratory muscles.	Whole lung.	Diseases of the cerebro-spinal apparatus.
Frequent respiration.	If the *extent* of the respiratory movements is diminished, the *number* is increased to supply the deficiency. Derangement of hæmatosis.	Entire lung.	Inflammation of the thoracic or abdominal organs. Exaggerated activity of circulation.
Jerking respiration.	Interference with the continuous expansion of the chest,	Whole of one side, or infra-clavicular region alone.	Asthma. Pleurodynia. Incipient phthisis. Chronic pleurisy with adhesions.

Name of the Sign.	Physical Cause of the Sign.	Ordinary seat of the Sign.	Diseases in which it is observed.
	either from pain, or, under certain circumstances, from the presence of pleuritic adhesions.		
Harsh respiration.	Condensation or rarefaction of the pulmonary substance, and dryness of the mucous membrane of the bronchial tubes.	Summit of the chest in tubercular diseases. In other cases it is variable.	In vesicular emphysema. In incipient phthisis; in fact, in all cases where there is pulmonary induration, as melanosis, cancerous infiltration, chronic pneumonia, &c.
Prolonged expiration.	In the healthy condition the air makes its escape from the lung, easily and without hindrance, and produces in consequence only a short and feeble sound; but when morbid productions, as tubercles, are infiltrated into the pulmonary parenchyma, these bodies produce prominences on the interior of the final bronchial ramifications, and the air meets with obstacles in its egress, which increase the friction, and, hence, there results an in-	Generally at the summit of the lung, sometimes over a more extended surface.	Pulmonary emphysema. Tubercles in the first stage of development. Hepatization of root of lung.

	crease in the force and duration of the expiratory sound.		
Bronchial respiration, (including blowing and tubal varieties.)	Condensation of the pulmonary substance.	Same as harsh respiration.	Inflammatory hepatization. Tuberculization of the lung. Pulmonary apoplexy. Liquid effusions into the pleura. Tumours compressing the lung. Dilatation of the bronchi with induration of the surrounding tissue.
Cavernous respiration.	Passage of air into a dilated bronchus, or into a hollow space in the interior of the lung.	Summit of one or both lungs, Central portion. . . . Any other part of the lung.	Tuberculous cavity. Dilatation of the bronchi. Cavity from abscess, sphacelus, softening of cancer, pulmonary apoplexy.
Amphoric respiration.	Passage of air into a large cavity, by a moderately wide opening from the air passages, above the level of any liquid contained in the cavity.	About the middle of the chest, to one side, and a little posteriorly.	Pneumothorax, with pulmonary fistula. Excavation of large size in the lung, from tuberculous or other disease, as sphacelus, abscess, &c.
Soft or grazing friction sound.	Slight asperities on the surface of the pleura, which have lost their polish and become dry. In the movements of respiration they rub upon each other.	"Variable, not only in different cases, but from day to day in the same subject. Sometimes at apex of lung."	In pleurisy, in the forming stage, and in tubercles of the pleura, if heard at the summit of the chest.

Name of the Sign.	Physical Cause of the Sign.	Ordinary seat of the Sign.	Diseases in which it is observed.
Hard or grating friction sound.	Thick false membranes, without adhesions.	"Where the cause is idiopathic pleurisy, the central height, and inferior part of the chest posteriorly, and laterally; where the cause is tuberculous pleurisy, sometimes at the summit. In cases of advanced emphysema, at the posterior inferior part of the chest (!)"	"Pleurisy" { Period of plastic exudation. Period of absorption with or without contraction of the chest."
Sibilant rhonchus.	1. "Presence of viscid mucus in, and modifying the form and calibre of the bronchus temporarily, and itself becoming the seat of vibration, which is transmitted to the tubes. 2. "Permanent alteration of calibre of bronchi from external pressure.	"Commonly, generally over both sides of the chest, or in other cases limited to some spot in particular, the site of which is variable."	Inflammation or catarrh of the bronchi, acute or chronic. Pulmonary emphysema. Tumours pressing on the bronchi.
Sonorous rhonchus.	1. "Presence of viscid mucus in, and modifying the form and calibre of the bronchi,	Same as the sibilant.	"Same as the sibilant; the precise condition of the diseases vary commonly, in the two cases however;"

and itself becoming the seat of vibration. 2. "Permanent alteration of calibre of bronchi from external pressure."

Crepitant rhonchus.	Presence of viscid mucus in the minute bronchial terminations, the walls of which being in contact after expiration, are forced apart by the entrance of the air in inspiration.	Varies; most commonly, at the base of either lung.	Pneumonia, in the stage of engorgement, particularly in certain forms of pulmonary congestion, œdema, and apoplexy of the lungs.
Sub-crepitant rhonchus.	Bubbling of air through liquid of variable consistence in minute bronchial tubes.	Inferior and posterior parts of chest on both sides. Superior part of lung on either side.	Bronchitis in the second stage. Different varieties of catarrh of the pul. mucous mem., dilatation of the bronchi with excessive secretion. Certain forms of congestion and pulmonary apoplexy. And phthisis at the commencement of the period of softening.
Dry Crackling rhonchus.		"Wherever tubercle exists in the first stage; hence, in the great majority of cases the summit of the lung anteriorly and posteriorly;—that is, *primarily*; it may appear *secondarily*, however, in a	"Unsoftened tubercle in moderate quantity."

Name of the Sign.	Physical cause of the Sign.	Ordinary seat of the Sign.	Diseases in which it is observed.
		lower situation, when the disease has advanced to the second stage superiorly. It has not yet been detected as a primary condition in those rare cases, in which tuberculization commences inferiorly."	
"Humid crackling rhonchus."	Bubbling of air through liquid of variable consistence in minute bronchial tubes.	Summit of either lung.	"Tubercles commencing to soften."
Cavernous rhonchus.	Bubbling of air through liquid contained in a hollow space in the lungs, the bubbles are larger, irregular in size, and less numerous than in the last, and joined with cavernous respiration.	Summit of one or both lungs. Central part of lung. Indifferently in any part....	Tuberculous excavation. Extensive dilatation of bronchi. Excavation from abscess, sphacelus, communication of pus contained in pleura or elsewhere, with bronchi; some destruction of substance attending. Softening of cancer. Pulmonary apoplexy.
Cavernulous rhonchus.	Bubbling of air through liquid. Smaller bubbles, clearer tone, without admixture of cavernous respiration.	Summit of one or both lungs.	Tuberculous excavation.

"Weak vocal resonance."	Diminished conducting power of substance of lung, or presence of non-conducting medium between the lung and the walls of the chest.	Anterior surface of either side (especially the left,) also the bases posteriorly.	Atrophous vesicular emphysema. Pneumothorax."
Exaggerated vocal resonance, or slight Bronchophony, is characterized by a rather stronger resonance of the voice than natural, not, however, to the extent of the bronchial voice. It usually accompanies similar, but less marked, and less extensive alterations.			
Bronchophony.	1. Unnatural density of the pulmonary tissues surrounding the bronchi, rendering them a better conductor of sound than the healthy lung. 2. Presence of an indurated adventitious mass in the	At the summit. Base, commonly. Central height. Variable.............	Tuberculous infiltrations. In pneumonia. In pleurisy with effusion. { In other cases of solidification of the lung.

Name of the sign.	Physical cause of the Sign.	Ordinary seat of the Sign.	Diseases in which it is observed.
		same situation. 3. Dilatation of the bronchi.	
Ægophony.	"A thin stratum of fluid, compressing the lung, and commonly (but not necessarily) contained in the pleura."	Generally on one side, in the lower half of the infra-spinous space, (rarely on both;) when it occupies a more extensive surface, it is still most strongly marked at this point.	Pleurisy with effusion. Hydrothorax. Pleuro-pneumonia.
Cavernous voice, or Pectoriloquy.	Concentration of the vocal resonance in a hollow space in the lung, from the walls of which it is reflected with more or less distinctness.	Generally at summit of lung. Central part, ... Variable, ...	Tubercular excavation. Dilatation of the bronchi. { Purulent, apoplectic, gangrenous, or cancerous excavation.
Amphoric voice.	Cavity containing air and fluid, communicating with the bronchi.	Same as amphoric respiration	Pneumothorax, with pulmonary fistula. Excavation of large size in the lung, from tuberculous or other diseases, as sphacelus, abscess, &c.
Bronchial or tubal cough.	Condensation of the pulmonary substance, enlarged bronchi, compression by fluid.	"Summit. . . . . . Base posteriorly, opposite root of the bronchi. Central height.	Tuberculous disease. Pneumonia. { Pleurisy. Dilatation of the bronchi. Chronic consolidation of the lung.

Cavernous cough.	Same as cavernous respiration.		
Amphoric cough.	Same as amphoric respiration.		
Metallic tinkling.	Drops of fluid falling into a liquid contained in a large cavity.	"Central height laterally or posteriorly, whence it may be propagated with gradually diminishing intensity to the surrounding parts; may be heard in every part of the chest."	Very large pulmonary cavity. Pneumothorax. Hydro-pneumo-thorax, with or without fistulous perforation of the bronchi.
Sound of thoracic fluctuation.	Collision of air and liquid in a large space produced by succussion of the trunk, or the voluntary movements of the patient.	Postero-lateral region.	Very large pulmonary cavity, half filled with liquid. Pneumo-hydro-thorax. It nearly always accompanies amphoric respiration and metallic tinkling.

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AUSCULTATION OF THE LARYNX.

Name of the Sign.	Physical Cause of the Sign.	Ordinary seat of the Sign.	Diseases in which it is observed.
"Harsh laryngeal respiration.	Passage of air along the surface of rough or ulcerated mucous membrane; also through larynx, the form of which is altered by external pressure.	Opposite the larynx. Extending into the trachea a certain distance.	Acute and chronic laryngitis, with or without ulceration, or diminution of calibre of tube. Tumours pressing upon the trachea from without. Croup."
Sibilant laryngeal rhonchus.	"Passage of air through a larynx of diminished calibre.	Over the larynx and lateral parts of the neck; sometimes audible at the upper part of the chest, even without applying the ear or stethoscope."	Spasm, or œdema of the glottis. Stridulous laryngitis. Foreign bodies in the air passages. Compression of the trachea.
Sonorous laryngeal rhonchus.	Same as sibilant.	Same as sibilant.	Laryngeal ulceration with thickened edges. Laryngeal vegetations. Croup.
Laryngeal cavernous rhonchus, or gurgling, laryngeal rhonchus.	Passage of air through the larynx, and trachea filled with mucus or other fluid.	Larynx and trachea.	"Hæmoptysis.—Laryngeal ulcerations. Foreign bodies in larynx or trachea. Close of life in various diseases, (death rattle.")
Tremulous laryngeal rhonchus, or flapping laryngeal rhonchus.	Vibration of false membrane, produced by the passage of air, to and from the lungs.	Opposite the larynx, or along the trachea, may even extend into the larger bronchi.	Membranous croup, with portions of the exudation partially detached.

CHAPTER II.

AUSCULTATION OF THE CIRCULATORY APPARATUS.

This includes the auscultation of the *heart* and of the *great vessels*.

ARTICLE I.

AUSCULTATION OF THE HEART.

I. *Physiological Phenomena.*

In the healthy condition, when the ear is applied over the precordial region a kind of *tick-tack* is heard, formed by two successive sounds, which occur regularly from sixty to eighty times in a minute.

The *first* of these sounds, which is dull, deep, and more prolonged than the second, coincides with the impulse of the apex of the heart against the chest, and immediately precedes the pulse in the radial artery; it has its maximum intensity between the fourth and fifth ribs, below and a little to the outside of the nipple. The *second*, which is clearer, shorter, and more superficial, is produced after the pulsation in the arteries, and its maximum intensity is nearly on a level with the third rib, a little above and to the right of the nipple.

Considered in relation to their *rhythm*, these sounds succeed each other in the following order; first, a *dull sound*, then a *short silence* followed by a *clear sound*, and lastly, a *long silence;* each couple with their intermediate periods of repose, constituting a complete *beat*. These beats, numbering from sixty to eighty in adults, are more *frequent* in childhood; exercise, and moral emotions also accelerate them. Their *strength* varies in proportion to the energy and rapidity of the contractions of the heart, and according to the idiosyncrasy of the individual and the physical conformation of the thorax: they are more intense in nervous subjects, in narrow and contracted chests, &c. Their *extent* is equally variable: they are distinct at the precordial region, and grow weaker in proportion as we depart from this point; they are also easily perceived on the right side in front; they are less distinct on the left and behind, and are scarcely perceptible on the right side posteriorly. They vary also in extent according to the condition of the surrounding organs, which conduct the sounds more or less clearly. Their *tone* offers many differences of shade: but they are at the same time clear, and neither rude nor rasping.

The mechanism of these sounds has been very differently explained. The following are the conclusions to which reasoning and experiment have brought us:

The series of movements of the heart commences by the contraction of the auricles; immediately after comes the contraction of the ventricles, followed by their diastole.

The impulse of the heart, and consequently the dull sound, coincide with the *contraction* of the *ventricles* and the *diastole* of the *great arteries;* the *second* sound corresponds to the *dilatation* of the *ventricles,* and the *systole* of the arteries in the neighbourhood of the heart.

The *first sound* is produced by the conjoined action of the muscular contraction of the ventricles, the shock communicated to the inferior surface of the sigmoid valves, and to the base of the columns of blood contained in the pulmonary artery and aorta, by the *clacking* of the auriculo-ventricular valves, and the impulse of the apex of the heart against the chest.

The *second sound* is owing principally to the shutting down of the sigmoid valves, and the shock upon their concave surface, produced by the reflux of the blood in the aorta and pulmonary artery.

II. *Pathological Phenomena.*

In the *morbid condition*, the sounds present different alterations in regard to their *seat, extent, intensity, rhythm* and *quality;* they may also be preceded, accompanied, followed or replaced by *abnormal sounds.*

I. *Alteration of Seat.*

Sometimes the sounds of the heart change their position, and their maximum no longer corresponds to the points already indicated. These *changes in situa-*

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tion may depend upon lesions of the heart, pericardium, large vessels, or surrounding organs.

The *depression* of the sounds may be owing to tumours situated at the base of the heart, which lower its position, or to hypertrophy with dilatation of the auricles; their *elevation*, to the forced ascent of the diaphragm; their *lateral displacement*, to effusions of liquid or gas into the pleura ; their *displacement posteriorly*, to tumours of the anterior mediastinum. Morbid adhesions of the heart to the pericardium, rachitic malformations of the thorax, general or partial hypertrophies, may also displace the sounds in different ways.

2. *Alterations of intensity and extent.*

Under certain circumstances, the pulsations are only perceptible at the precordial region, and even here they are so *feeble* and so imperfectly transmitted to the ear, as to be scarcely appreciable. At other times, on the contrary, they are *strong* and distinctly marked : the ear, placed upon the region of the heart, is elevated by the energetic contractions of that organ, and perceives very clearly the two sounds in every point of the thorax, sometimes even *at a distance*, so great is their intensity and so perfect their transmission.

A diminution in the extent and force of the sounds may depend upon atrophy of the heart, concentric hypertrophy, softening, local atony or general debility, or even upon the presence of an effusion into

the pericardium, or emphysema of the anterior border of the left lung.

An *increase in the extent and force of the sounds* may depend, either upon hypertrophy with dilatation of the cavities of the heart, upon induration of the muscular tissue of its walls, upon nervous palpitations, upon a condition of general morbid excitability, or even upon alterations of the neighbouring organs, such as pulmonary hepatization, tubercles, &c.

3. *Alterations of Rhythm.*

The sounds of the heart may be altered in their *frequency, their order of succession,* and in the *number of sounds* which correspond to each beat. Without mentioning the febrile condition, in which the *frequency of beats* may rise as high as 140 or 150 per minute, there are certain important affections of the heart where they exceed this number; and sometimes they are accelerated to such an extent that they cannot be counted. As to the *retarding of the beats,* the number of which may be diminished to 30, 20, or even 16 in the minute, it is most frequently dependent upon diseases of the encephalo-spinal system, or the action of digitalis.

The order of succession may be interrupted in very different manners; sometimes one of the sounds, (generally the first,) is more *prolonged,* as is observed in cases of hypertrophy with contraction of the arterial orifices; sometimes this prolongation extends into one of the *periods of repose,* (generally the long;) it

may depend upon the obstruction that the blood experiences in entering the ventricles, and may cause us to suspect the *existence of auriculo-ventricular narrowing*. At other times an *irregularity* is observed in the beats, which are either hurried or retarded ; or sometimes they experience an arrest, the duration of which equals that of an entire beat; this constitutes an *intermission*. These perversions sometimes combine also in a variety of ways, and the beats then become *confused* and *tumultuous*. These disorders, temporary or permanent, may depend upon simple nervous disturbance, or upon organic alterations of very diverse characters.

In regard to the *number of sounds*, sometimes *only one* is perceived, as when the first is so prolonged as to conceal the second, which is rarely observed, except in cases where it is transformed into an abnormal sound: sometimes, on the contrary, we hear *three* sounds; this phenomenon has been met with in some cases of contraction of the orifices; it has been attributed at other times to the addition of a clacking produced by hypertrophy of the auricle, whose contractions in a healthy condition are unproductive of sound; we have noticed also a *division* of the second sound towards the termination of some cases of pericarditis.—The formation of *four* sounds is equally dependent upon certain organic affections with contraction of the orifices. Lastly, the *triple* and *quadruple sounds* are ordinarily caused by a defect of synchronism in the movements of the right and left sides

of the heart; and more frequently still they result from the addition of abnormal sounds.

4. *Alterations of Character.*

The sounds undergo many modifications of *tone:* they may be *clearer* or *duller* than in the normal condition. The clear sounds may be ascribed to *thinning* of the walls of the heart; the *dull*, on the contrary, announce *thickening* of the valves, and more frequently hypertrophy of the walls themselves.

Dry and harsh sounds appear frequently to accompany a certain degree of thickening and rigidity of the valves; *hoarse stifled* sounds have appeared to belong rather to a state of softening or infiltration of these membranous partitions.

The *metallic tone* (metallic tinkling of the heart,) may depend upon induration of the walls; but it is usually joined to an increase in the energy of the beats, particularly when the point of the heart strikes against the internal surface of the fifth rib.

Besides these, the sounds of the heart may lose their clearness, and become slightly *blowing* or *rasping*. These alterations in character point out the first stage of lesions in the valves and orifices, the existence of which, in a more advanced stage, will be discovered by abnormal sounds.

5. *Abnormal Sounds of the Heart.*

Abnormal sounds, that is to say, those of which no trace exists in the physiological state, are divided into

two classes: the *blowing sounds*, which are produced
in the cavities themselves; and the *friction sounds*,
which are formed outside the organ, in the pericardium.

1st Class.—Blowing Sounds.

We include under this title, the blowing sound, pro-
perly so called, or the "*gentle souffle ;*" *rasping ;
filing* or *sawing sounds ;* and lastly, *musical sounds,*
as the *whistling, the whining sound,* &c.

A. *Blowing sound,* (bellows sound.)—This is the
most common of all the abnormal sounds, and the name
itself is, perhaps, the best definition. It is more or
less soft to the ear, and either *single or double,* that
is, it may be perceived during either the systole, or
diastole, or in *both.* We meet with the *blowing sound :*
1st, in a large number of diseases with *extensive lesions
of the heart,* as *narrowing of the orifices, alterations
of the valves,* (fibrinous depositions, vegetations, in-
sufficiency, &c.,) *hypertrophy with dilatation, endo-
carditis,* &c.; 2d, in *diseases with changes in the cha-
racter of the blood,* as *anemia, chlorosis,* &c.; 3d,
in *diseases with nervous disturbance of the heart,*
as *palpitations,* &c.

If the *blowing sound* shows itself in so many and
such different affections, how can we positively re-
cognise its morbid signification? The first point to
be determined is this: if *the cardiac blowing sound is
present, is there organic disease of the heart* or not?
In order to decide this first question, we must study
in succession, the *character of the sound,* the *time* in

which it *shows itself*, its *persistence*, its *progress*, and finally, *all the accompanying phenomena*.

The sounds which accompany organic lesion of the heart are sometimes *soft*, but more frequently *rough*, and resemble *rasping*, *filing sounds*, &c. On the other hand, *blowing sounds without* material lesion are in the majority of cases *very soft*. The *former* accompany either the *first or second sound* of the heart; the latter are always heard during the *first*, and *never during the second*. The former are *constant*, and last for *months* or *years;* the latter are *intermittent* and *transient*. The *former* undergo progressive transformation from the *gentle souffle* to the *musical sounds*, in proportion to the length of time they exist, and as the lesions of the orifices become more *extensive* and *deeper seated*, the latter uniformly preserve their character of softness, whatever may be their modification of intensity.

Finally, *the rough sounds* are accompanied by local and general symptoms characteristic of disease of the heart, (dulness on percussion, a purring sound, irregularities of the pulse, considerable œdema of the inferior extremities,) whilst none of these phenomena show themselves either in anemia or chlorosis, at least, in a decided or persistent manner.

In recapitulation we may observe, that the soft quality of the sound, its exclusive connexion with the first sound of the heart, its intermission or short duration, and the absence of a number of serious symptoms, are in general the characteristics of the *souffle* which is

not connected with organic lesion of the heart, whilst
that which is indicative of extensive alteration of the
organ, has the opposite qualities of rudeness, coinci-
dence with both sounds or with the second sound only,
permanence and combination with other morbid symp-
toms.

The existence of a material lesion being admitted,
the next point is to discover its nature.   The souffles
indicative of pericarditis, hypertrophy, the formation
of a clot in the cavities of the heart, &c., are accom-
panied by peculiar symptoms, such as,—prominence
and dulness of the precordial region, diminution of
impulse with feebleness and distance of sounds, (peri-
carditis,)—dulness, increase of intensity in the sounds
and impulse (hypertrophy,)—the sudden appearance
of an abnormal sound with smallness of the arterial
pulse (formation of clots.)   These lesions being well
marked by their diagnostic signs, there remain only
the diseases of the orifices and valves, and in the con-
sideration of their principal effects, these may be ar-
ranged under two heads, *narrowings* and *insufficien-
cies*.

How shall we discover whether there be *narrowing*
or *insufficiency?*   To reply to this question we must
first examine the *time* to which the abnormal sound
belongs, determine whether it precedes or accompanies
the systole, or whether it coincides with the diastole
of the heart, and we can deduce from it the morbid
signification of the souffle, by recalling what takes
place at each of these movements.   Now reason and

experience demonstrate that *a souffle accompanying the first sound may indicate either a narrowing of the arterial orifices,* (causing increased friction of the blood in its onward progress,) or *an insufficiency of the auriculo-ventricular opening,* (which also gives rise to friction during the reflux of the columns of the blood.)—On the other hand, *a souffle accompanying the second sound, indicates arterial insufficiency,* or, more rarely, *an auriculo-ventricular narrowing. The sign of this last alteration, is frequently a pre-systolic souffle.*

The precise determination of the situation of the diseased orifice will now decide what is the nature of the lesion.

If we decide, for example, that there exists a lesion of the arterial orifice, in a case where the souffle replaces the first sound of the heart, we shall have diagnosticated an arterial narrowing.

But the seat of disease may be discovered by an accurate knowledge of the place where the maximum of the *souffle* is produced, and by considering whether it is extended into the large vessels, or whether it is heard only around the region of the heart. In fact, the souffle dependent upon a lesion of the sigmoid valves, has its maximum intensity above the nipple at the base of the heart, and may extend into the large arteries, whilst that dependent upon alteration of the auriculo-ventricular valves, has its maximum below the nipple, nearer the point of the heart, and does not extend into the great arterial trunks.

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If, then, a souffle accompanying the *first sound* has its *maximum intensity* at the *base of the heart*, and *extends into the large arteries*, it will indicate *arterial narrowing*. A souffle accompanying the first sound which has, on the contrary, its *maximum* at the *point* of the organ, *without* extending into the great arterial trunks, will indicate *auriculo-ventricular insufficiency*. On the other hand, a souffle accompanying the *second sound*, having its *maximum intensity above the nipple*, and *extending* into the *great vessels*, will announce *insufficiency of the sigmoid valves;* whilst the same sound, if it should have its *maximum below the nipple without* extension into the great arterial trunks, will diagnosticate *auriculo-ventricular* narrowing.

After having determined both the nature of the orifice and the variety of lesion with which it is affected, it only remains to decide whether *the alteration belongs* to the *right* or *left heart.** We may solve this

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* The spot where all endocardial murmurs are heard most distinctly, is immediately over the valve which originates them. And the space under which the cardiac valves lie, may be said to be comprised *between the lower margin of the 3d left costal cartilage, and the lower margin of the 4th;* extending inwards to the middle of the sternum. Here it is that almost all murmurs are heard most clearly.

The method of distinguishing them from each other is based on the fact that the murmur will be conveyed along the direction of the column of fluid whose vibration causes it.

Thus, if a murmur be seated at the aortic valve, it will be heard most clearly *over the left half of the sternum, between the 3d and 4th costal cartilages.* But the sound will also be con-

problem by examining the *relative seat* of the abnormal sound on one side of the heart, in comparison with the normal sounds of the other side. We know that conditions capable of producing these *souffles* appertain to both sides, and thus one of the two sounds may be altered in the left heart, and remain normal in the right, and conversely. If, then, for example, we hear to the left of a given point, the maximum of an abnormal sound, whilst more to the right we find the natural sound, we must conclude that the lesion and the souffle which reveals it, belong to the left heart, and vice versa.

Besides this, the diagnosis of diseases of the left cavities will be more confirmed by the presence of alterations in the pulse, and that of affections of the right cavities, by disturbance in the circulation of the large veins, and particularly the jugulars.

Thus far we have supposed that there existed but one souffle in the precordial region. Let us now sup-

veyed with tolerable clearness *in the course of the aorta and its branches;* that is to say, upwards and between the second and third ribs of the *right side*—perhaps it will also be heard in the carotids.

If the disease (which is very rare) were seated in the *pulmonic valves*, the murmur would follow the course of the *pulmonary artery*, upwards between the 2d and 3d ribs of the left side.

If it were seated in the *mitral valve*, the murmur would be lost if the stethoscope were moved upwards; but would still be heard distinctly if it were moved *downwards towards the apex of the heart*.

If the murmur is heard plainly in *both directions*, then *both aortic and mitral valves* are probably diseased.—*Tr.*

pose that it is *double*.   A double *blowing* sound may
be connected with the *four* different conditions which
follow: 1*st*, *arterial* narrowing and insufficiencies;
2*d*, *auriculo-ventricular* insufficiency and narrow-
ing; 3*d*, narrowing of both the *arterial* and *auri-
culo-ventricular orifices ;* 4*th, insufficiency* of these
two orifices.—The same considerations drawn from the
seat of the *souffle*, its extension, &c., will serve also
to determine the kind of compound lesion that exists.

Let us farther add, that of the four complex lesions
just mentioned, *all* are not equally frequent, and that
the diseases of the valves which produce *narrow-
ing*, (as thickening, induration, &c.,) are often also of
such a nature as to cause their insufficiency.   We
must hence conclude, that a *double blowing sound*
is rather the *indication of a double lesion of a sin-
gle orifice*, than of *two lesions*, one *situated* at an
arterial orifice, the *other* at an *auriculo-ventricu-
lar*.   And as the auriculo-ventricular narrowing often
exists without sound, it results that a double abnormal
sound, considered independently of the other elements
of the diagnosis, will indicate rather arterial narrow-
ing and insufficiency than any of the other three com-
pound alterations; further, as diseases of the valves
are more frequent on the left than on the right side,
*a double blowing sound generally announces a
narrowing of the aortic orifice with insufficiency
of the sigmoid valves.*

B. *Rasping, filing, and sawing sounds.*   These
abnormal sounds, which are sufficiently described by

their names, most frequently replace the first sound of the heart; sometimes they are double, and conceal the second as well as the first. They are permanent, and commonly do not disappear when once well established; it is more common, on the contrary, to see them transformed in time into musical sounds. They are almost always accompanied by a *vibratory thrill, (purring tremor,)* which is perceptible to the hand.

They almost invariably announce organic alterations of the orifices of the heart, and *narrowing more commonly than insufficiency.* The roughness of their character indicates generally greater friction, and consequently, more decided lesions than those indicated by the simple blowing sounds: these are, most frequently, cartilaginous or osseous indurations, calcareous depositions, &c.

C. *Musical sounds, whistling, whining.* — In addition to the sounds already described, we also hear in some cases *musical tones,* which have been compared to *whistling,* the *cooing of a dove,* or the *sibilant râle* of bronchitis.

According to M. Bouillaud, these sounds are only the highest degree and the most acute tone of the *blowing sounds,* and predicate very nearly the same physical conditions in their most aggravated form. In fact, *they are connected with important lesions of the valves, and principally with considerable narrowings of the aortic orifices, caused by osseous degeneration of the valves and calcareous deposition.*

In some rare cases this *musical whistling* of the

heart may be produced in alterations of the blood, such as chlorosis; independently of any material lesion of the organ; but this affection, if it is superadded to valvular lesions, tends especially to give the sibilant character to a cardiac souffle.*

* *Situation in which murmurs of the respective valves are most audible.*

Murmurs seated in the semi-lunar valves are best heard immediately over those valves, (that is, on the sternum, opposite to the inferior margin of the third ribs when the patient is horizontal, and a *little* lower when he is erect,) and thence for about two inches upwards, along the diverging courses of the aorta and pulmonary artery respectively. A distinct murmur high up the aorta proceeds from the aortic valves, as a pulmonic murmur is only feebly and indistinctly transmitted in that direction. It may be known that the murmur proceeds from the aortic valves rather than from the diseased ascending aorta itself, by its key not being higher than a whispered *r*, whereas a murmur from the aorta itself is commonly a tone or two higher, approaching towards an *s*, and also seems much *nearer* and more superficial.

A distinct murmur high up the pulmonary artery proceeds from the pulmonic valves, as an aortic murmur is only feebly and indistinctly transmitted in that direction. The pulmonic murmur, whether seated in the valves or in the pulmonary artery itself (as when dilated) always sounds near and superficial, provided the current be sufficiently strong; because the valves and artery are close to the surface, the valves being not only in front of the aortic valves, but half an inch higher up. A murmur in the pulmonic orifice is more audible down the tract of the right ventricle than of the left—which is a corroborative circumstance.

Murmurs seated in the auricular valves are best heard at that part of the præcordial region, where, from the heart being in contact with the walls of the chest, there is dulness on percussion—in short, about the apex; for the murmur is best conducted (by the columnæ carneæ) to the surface through a solid medium.

2d Class.—Friction Sounds.

Pericardial friction sound.—Under the generic name of *pericardial friction sound,* we include many phenomena which have a very great analogy with the different varieties of *pleural* friction sound,

The upper and *left* side of the dull portion, being nearest to the mitral valve, is the best point for exploring its murmurs; and this point will generally be found situated about the fifth rib or subjacent intercostal space, and a little to the right of the nipple: in females, it is under the mamma when pretty well raised, and a little to the right of its centre. If the impulse of the heart be perceptible, there is no better guide to the situation in question. The auscultator has only to place his stethoscope about an inch above the spot where the apex impinges.

The upper and *right* side of the dull portion, being nearest to the tricuspid valve, is the best point for exploring the murmurs of this valve; and the point will generally be found on or near the sternum at the same level as on the opposite side. If, in making these explorations of either valve, the stethoscope be placed half over the dull portion and half over the thin resonant edge of the lung, the object will be sufficiently answered.

In exploring a delicate murmur, the auscultator should hold his own breath, and request the patient to inspire very fully, then free the air from the lungs by expiration, cease respiration and lean forward. The patient by these means will be enabled to hold his breath for some time, and the heart will be thrown more upon the parietes of the chest. The utmost attainable silence should reign in the room. If an expert auscultator can hear in a noise, it is because he catches the sound during the momentary intervals of silence, but the learner must not expect to accomplish this. He should always endeavour to keep his head erect and his neck straight, otherwise cerebral congestion will impair the nicety of his hearing.—(Condensed from Hope on Diseases of the Heart and Arteries, by Pennock, p. 114. Philadelphia, 1846.) *Tr.*

and which are caused by similar anatomical conditions.
Thus, we distinguish the *soft friction* or *grazing
sound*, and the *rough* or *crackling sound*, very
analogous to the *rasping;* the *new leather sound,*
which resembles the creaking of a new sole under the
movements of the foot, and the *scraping*, a still ruder
form of friction sound, analogous to that produced by
rubbing together two dense and solid membranes.
*The friction sound diagnosticates the existence of
pericarditis with false membranes, and the pre-
sence of little fluid.* The *grazing sound* denotes
that the *pseudo-membranous exudation* is *recent,
soft, thin,* and *slightly rugose.* The *harsh friction
sound* announces that the false membranes are *thicker,
reticulated, uneven* and *rough.* The *new leather
sound* indicates, in general, that they are *more firm,
resisting,* and *elastic.* Finally, the *scraping
sound* is connected with the formation of *harder* mor-
bid products: such as *cartilaginous* or *osseous plates
in the false membranes, laminæ* of *osseo-calcareous*
matter developed in the walls of the pericardium, or
even *solid concretions* lodged between the fibres of
the heart, producing a prominence under the serous
membrane which invests it.

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ARTICLE II.

AUSCULTATION OF THE LARGE VESSELS.

Let us now study in succession the sounds furnished
by the *aorta,* the *arteries,* and the *veins.* In the

normal condition we hear in the course of the *tho-racic aorta* two sounds, which the ear cannot distinguish from those of the heart; and throughout the length of the *abdominal aorta* we perceive only a *single* sound, corresponding with the diastole of the vessel.—Over the arteries, in the neighbourhood of the heart, we hear also two sounds; over the more distant we hear but *one*, which becomes more feeble as we listen farther from the centre of circulation.—Finally, over the veins, the ear does not perceive the trace of any sound. In the *pathological condition* abnormal sounds are produced in various parts of the vascular system.

1st, *Aortic Sounds.*

In the diseases of the aorta, auscultation reveals sometimes a *single sound,* made up either of a *blowing, rasping, sawing,* or a more or less prolonged *rustling sound;* sometimes a *double sound analogous to that of the heart,* or a *double souffle,* or finally a *clacking,* preceded or followed by a *souffle.* —Some of these sounds are but the transmission of those which occur in the heart, the others are *intrinsic.* In general, the morbid sounds are *double* in the region of the *thoracic aorta,* and *single* in that of the *abdomen.* They may point out numerous lesions either of the very orifice of the aorta, such as *narrowing* or *insufficiency,* or of the interior of the vessel, as *pseudo-membranous* or *cartilaginous deposits, calcareous,* and *osseous incrustations, ulcera-*

tion of the internal tissue, narrowing, dilatation,
and *sacculated* or *varicose aneurisms.* The signs of
narrowing and insufficiency of the aortic orifice having
been pointed out above, we will describe here only
the phenomena belonging to diseases of the vessel
itself.

A rough *blowing sound,* or a *rasping sound,* per-
ceived exclusively in the direction of the aorta, and of
considerable extent, reveals the existence of *rugosi-
ties* on the internal surface of the vessel, which de-
pend on *recent false membranes* if there is fever, and
on cartilaginous or calcareous plates if there is a con-
currence of apyrexia, particularly if it occur in an old
person whose radial artery presents ossifications.—
This same blowing sound, when limited to a small ex-
tent of the aorta, may cause us to suspect *local nar-
rowing* of the vessel, particularly if we witness simul-
taneously energetic pulsations of the arteries, occur-
ring above the narrowed portion.

A blowing or rasping sound perceived during the
first sound, behind the sternum, with dulness at the
same point and a purring, (without swelling) would
indicate *dilatation of the ascending aorta;* and if
this same sound were followed by a souffle during the
second sound of the heart, we might infer that there
was, in addition, insufficiency of the aortic valves.

A systolic blowing and a *diastolic rustling
sound,* independent of the sounds of the heart, which
remain *natural,* would render probable the existence
of an *aneurismal pouch,* which the blood enters and

leaves with noise. The diagnosis will be more certain, if, to the stethoscopic phenomena, are joined *dulness, vibratory humming,* and *impulse;* and there will be no doubt, whatever, on the subject, if we can perceive at the same point a pulsating tumour.

A *double clacking sound,* analogous to the double sound of the heart, having its maximum intensity on a level with a tumour agitated by indistinct movements of expansion, would cause us to conclude, that it was produced by *an aneurismal sac filled with clots.* Finally, an intense prolonged *whizzing sound,* perceived independently of the sounds of the heart, over one of the points where the aorta is in relation with the venous system, will announce the existence of a *varicose aneurism of the aorta.*

In the *abdominal aorta,* the same morbid sounds (generally single) such as, a single exaggerated beat, a blowing or rasping sound, a rustling, &c., will have a similar pathological signification, provided they coincide with the other phenomena above mentioned. Finally, we sometimes establish in the course of the abdominal aorta, an exaggeration of the normal beats, without the existence of any material lesion. These pulsations point out the morbid condition described by Laennec, under the name of *palpitation of the aorta.*

2d, Vascular Sounds.

The greater part of the abnormal sounds produced at the mouth of the aorta, or in its course, may be heard also in the arteries which have their origin from

it; but besides these phenomena of transmission, there are pathological sounds whose origin is in the *arteries themselves;* others occur more particularly in the *veins;* and some, finally, result from the combination of both *arterial* and *venous* sounds.

A. *Arterial sounds.* We sometimes hear in the course of the arteries an *intermittent blowing,* soft to the ear, coincident with the dilatation of the vessel, and perceived most frequently in many arteries at the same time, but more frequently in the carotids, of which it is more common in the right than the left. Sometimes the blowing is harsher: being a true *rasping sound* very seldom extensively distributed, and commonly accompanied by a humming which is perceptible to the hand.—At other times there is a more prolonged and sharper *whizzing sound,* generally limited and coincident likewise with a manifest vibratory humming.

In general, the rougher and more circumscribed the sounds are, the more certainly will they announce *material lesion* of the *artery.* Such as narrowings, rugosities of the internal surface, aneurismal dilatations, compression by tumours, &c., we meet with the continued whizzing sound more particularly in *varicose aneurisms.* On the contrary, the softer and more distributed the souffles are, the more they announce alteration of the entire economy, as disease of the blood, and particularly chlorosis and anemia.

B. *Venous* and *mixed vascular sounds.* The sounds which we include under this title are, in general, con-

tinuous, and present various shades of tone and character. Sometimes there is a dull diffused murmur, like that we hear when the ear is applied to a shell, (simple, continued murmur.) Sometimes there is a more intense murmur continued, like the former, but re-enforced at each contraction of the heart, and which gives the sensation of two currents moving in opposite directions, (double current blowing sound,) very like the sound of a forge bellows; it sometimes becomes roaring and sonorous, closely resembling that produced by the child's toy, the humming top; it then constitutes the *bruit de diable*. Finally, we hear at other times, either alone or combined with one of the two preceding varieties, a *sibilant* and *musical sound*, produced by a succession of variously modulated tones, which have been compared to the resonance of a tuning-fork, or to the vibration of a metallic cord, (musical sound, singing murmur of the arteries.) These three kinds of sounds are very variable in their intensity and character: they are modified, increased, or diminished, by the least change in the tension of the parts or in the pressure of the stethoscope. They show themselves principally in the vessels of the neck, oftener on the right than on the left side, and still more frequently in the female than the male. These vascular sounds are connected almost exclusively with the diseases of the blood: they are the most certain indication of *advanced chlorosis,* and of *anemia with considerable diminution of the blood corpuscles.*

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CHAPTER III.

AUSCULTATION OF THE ABDOMEN.

NOTHING is heard, in ausculting over the belly in the normal condition, but the movements of gas in the digestive tube, and the aortic pulsations before-mentioned. The greater part of the acts performed in the abdomen do not produce any appreciable sound. The movements of the parts invested by peritoneum, which normally carry on their operations in silence, may give rise to a *friction sound* when the inflamed peritoneum is covered with false membranes, which is much more rare and feeble than the *pleuritic* friction sound, and is only produced in the neighbourhood of slightly resisting organs, as, for example, the liver.*

* The presence of plastic lymph with partial adhesions, is indicated at an early stage by a remarkable symptom, which was discovered a few years ago by that eminent pathologist, Dr. Bright, of London. It consists in a peculiar crepitating sensation, not unlike what is produced by bending a sheet of new leather, which is recognised by the hand when applied to the abdomen in a mode calculated to facilitate motion. It has also been likened to the obscure creaking of pulmonary emphysema, and to the sensation caused by passing a wetted finger over a pane of glass. It is felt both during the ascent and descent of the diaphragm, but more distinctly during the latter, and appears to result from the friction of the roughened surfaces of the peritoneum. This symp-

Shocks communicated to the body sometimes give rise to a *sound* of *fluctuation* in the stomach, which is very distinct in cases of narrowing of the pylorus. In stricture of the intestine we also frequently hear a *wave sound*, which is due to the displacement of liquids by the energetic contraction of the hypertrophied intestine. *Gurgling* perceived in a hernia will announce the existence of an enterocele. A *trembling motion* developed by percussion in a tumour in the right hypochondrium will indicate the presence of *an hydatid cyst*. A sound of *crepitation* produced by pressure over the region of the gall-bladder will cause us to suspect an accumulation of *biliary calculi;* pressure over the loins may produce an analogous *friction sound* in the case of *numerous renal concretions*. The presence of one or more calculi in the bladder may be equally recognised by a peculiar *clicking*, produced by a blow of the catheter, and transmitted to the ear by the stethoscope applied over the pubis, or by the *sound itself* furnished with an acoustic tube. Finally, if we should happen to distinguish a *double pulsation* in a large tumour of the ovary, we may conclude that it is produced by an *extra-uterine pregnancy*.

tom, it should be added, is to be perceived only when the lymph, upon the presence of which it depends, is of a plastic, organizable character, competent to form adhesions, and never lasts beyond a few days.—*Tr.*

CHAPTER IV.

AUSCULTATION OF THE HEAD.

LIKE that of the abdomen, auscultation of the head furnishes very little semeiological information. Dr. Fisher,* of Boston, has described a *cephalic bellows sound* in cases of congestion, compression, and other diseases of the brain. Dr. Whitney† has thought he

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* See Amer. Jour. Med. Sciences. August, 1838—(*Tr.*)

† This gentleman has published a long paper in Amer. Jour. Med. Sciences, Oct., 1843, in which he says, that the auscultic phenomena cannot be detected in a truly physiological condition of the brain, and are incompatible with it; that they cannot be considered in any other light, therefore, than the *natural phenomena* of certain pathological conditions of the brain. He describes *four* perfectly distinct auscultic phenomena, which are developed by, and characteristic of, *particular* pathological states of the encephalon. They are, 1st, the *cephalic bellows sound ;* 2d, the *encephalic* or *cerebral ægophony ;* 3d, the *frémissement cataire* or *purring thrill ;* and 4th, the *bruit de poussin, cooing or musical sound.*

The *first of these*, in a pure or modified state, has been noticed as the accompanying phenomenon of *cerebral congestion; acute cerebral inflammation ; hydrocephalus ; compression of the brain; scirrhous induration of the substance of the brain with softening; ossification of the arteries of the brain,* and *the hydrencephaloidal disease.*

The *second* has been noticed only in those cases of cerebral

heard *cerebral ægophony* in cases of effusion. According to Gendrin, alterations of the arteries, even of the interior of the cranium, may manifest themselves by abnormal sounds. Finally, Ménière believes that the introduction of air into the tympanum produces a *blowing sound* when that cavity is empty, a *whistling* when it is very dry, and a *bubbling rhonchus* when there are liquids present which the air penetrates in entering.

disease which are accompanied with effusion and extravasation of fluid in and about the substance of the brain.

The *third*, in aneurism of the basilar artery; and

The *fourth*, which, properly speaking, is only an extraordinary modification of the bellows sound, is never found accompanying any state of active hyperemia or active inflammation of the brain, and therefore, may be considered strictly pathognomonic of a state of *excessive anemia* of that organ.—*Tr.*

CHAPTER V.

AUSCULTATION OF THE EXTREMITIES.

In addition to the sounds furnished by alterations of the arteries, of which we have spoken above, we hear an evident *blowing sound* over certain erectile tumours.

The sounds produced by the contact of a probe with a foreign body, at the bottom of a wound, will often reveal to us the nature of the substance. In some patients affected with gout, the slipping of the opposite articular surfaces upon each other causes us to hear a friction sound analogous to that of the pleura. In doubtful cases the application of a stethoscope over the seat of a fracture will sometimes enable us to detect, by the least displacement, a crepitation which would have escaped the ear, even with much more considerable movement.

OBSTETRICAL AUSCULTATION.

During pregnancy, after the first half of gestation has passed, we hear several sounds, one of which is connected with the maternal circulation, (the uterine

souffle,) the others with the fœtus: the latter are caused either by the beating of the heart of the embryo, (sounds of the fœtal heart,) or by its movements in the womb, (sounds of displacement of the fœtus.)

Sometimes, again, we perceive a souffle synchronous with the fœtal pulse, which appears to extend into the cord, when this vascular trunk is twined around the neck of the fœtus, or simply compressed between the back of the child and the uterine walls, (umbilical souffle.) This last sound is much more rare and much less important than the preceding.

A. The *uterine souffle* is soft, synchronous with the pulse of the mother, more or less prolonged, sometimes of a sonorous, sometimes of a more acute tone, and sometimes even a little musical. It is most commonly heard towards the inguinal regions, but is moveable, and may disappear for a moment, and again be reproduced, without any fixed law. It commonly makes its appearance towards the fourth month, and after the fifth is rarely absent. As the uterine souffle is almost a constant phenomenon in pregnancy, and extremely rare in other conditions, it is a very *probable* but not *certain* sign of gestation; and for the sole reason that it fails in some cases, its absence is not sufficient to exclude the idea of pregnancy.

B. *Sounds produced by the movements of the fœtus.* These are sometimes either single or repeated blows, or sometimes a dull and prolonged friction sound, giving the evident sensation of a body changing its position. These phenomena generally begin to be

perceptible towards the fourth month, and when they are very evident, they announce, with certainty, the presence of a *living fœtus*.

C. *Sounds of the fœtal heart.*—These are *double beats*, similar to those perceived in ausculting the heart of a new-born child. They generally begin to be heard towards the fifth month, and at first are weak and hurried, (140 to 150 per minute;) gradually, however, they increase in force and diminish a little in number, (120 to 130.) Their frequency and intensity are also subject to momentary variations, independent of the maternal circulation.*

* Writers, including Laennec, have said so much on the difficulty of hearing the fœtal beat, that the following preliminary directions, by which that difficulty may, in a great measure, be obviated, will not, perhaps, be unacceptable to the novice.

It is useless to attempt an examination in the erect position, and through the ordinary dress. The stays should invariably be taken off, as their compression above tightens the walls of the abdomen below. The patient should be in bed, on her back, with the shoulders raised and the knees drawn up and supported; and she should be covered by a chemise only, or a single sheet of soft quality, as stiff linen creaks under the stethoscope. The abdominal walls are thus completely relaxed, so as to allow the fœtus in utero to be readily felt, the situation of its back tolerably well ascertained, and the stethoscope to be pressed down into solid contact with the uterine tumour. This depression of the instrument should be exercised solely with the head of the auscultator, and not with his hand, as the bruit musculaire of the latter greatly obscures the fœtal sound. The impossibility of exercising similar depression when the ear alone is employed, constitutes the advantage of *mediate* over *immediate* auscultation in the exploration of the abdomen. Profound silence is desira-

The part of the abdomen in which they are heard varies in different women: moreover, it frequently changes its seat in the same woman. But generally towards the end of pregnancy the double sound becomes more fixed, and we find it most commonly towards the left iliac fossa. Besides these momentary variations in intensity and character, it may in cases of disease of the fœtus be changed into a souffle, and it ceases entirely, on the death of the child.*

ble; the auscultator should hold his breath, and he will find his delicacy of hearing increased by also opening his mouth. He should carefully avoid a stooping position and the slightest bend of the neck, both of which circumstances impair the hearing by causing congestion of the head. These two latter reasons constitute almost as strong objections to short stethoscopes as to the naked ear.

The beat exactly resembles that of a young rabbit or kitten, and is closely represented by the tic-tac of a watch thickly covered by a pillow. It is feeble during the first half of the fifth month, but by the end of the month it becomes strong and distinct, when listened to in the best situation. M. Dubois says that when the beats are quite distinct, they are *very frequently* attended with a bellows-murmur, and he ascribes this to the mixture of the two columns of blood of the pulmonary artery and aorta. Bouillaud has heard an approximation to bellows-murmur in a few cases.—(Hope on Diseases of the Heart and Arteries, by Pennock, p. 143. Philadelphia, 1846.)—(*Tr.*)

* The spot where the fœtal beat is most audible, varies according to the position of the infant, which, especially during the seventh and eighth months of pregnancy, is perpetually changing its posture. The part of the uterus to which the rounded back and shoulders of the fœtus are applied, is that where the sound is most audible; since, if the stethoscope be well pressed down, not only any interposed intestine, but also the liquor amnii is dis-

As this sign is never absent after the fifth month, it is of great value. Absence of the double pulsation does not always prove that there is no pregnancy; it is of little importance in the first four months, but after the fifth every day corroborates the presumption of the non-existence of the fœtus, without, however, posi-

placed, and the back of the infant, the uterus and the abdominal walls form one solid conductor for the sound. This part will most commonly be found on one side or other, in a line from the umbilicus to the anterior inferior spinous process of the ilium, but occasionally it is more centrical. During the early part of the fifth month, the part is very low down, because the uterus has not risen high into the abdomen. Its extent after the fifth month may be considerable—equal to an expanded hand. The sound diminishes in intensity on receding in any direction from the focus of the part in question. On commencing his examination, the practitioner should place his hand on the relaxed abdomen, and feel for the hardest and most prominent part of the uterine tumour, where, in the great majority of instances, he will at once find the tic-tac in full perfection. If he fail, he should try the other side: if he again fail, he should incline the mother to the sides as he successively examines them, since the movement may cause the back of the fœtus to gravitate to the dependent side. If he still be disappointed, he should apply a cold hand to the abdomen, or exercise some manipulations, which may occasion a favourable change of position by exciting the efforts of the fœtus itself; for, as Laennec remarks, it may probably sometimes be so placed as not to touch the anterior half of the uterus with any part of its back, and such he imagines to be the case when the sound is not audible for hours or days together. By attention to the above rules, however, I have seldom failed to discover it in a few minutes. Once, when showing it to my colleague, Dr. Robert Lee, the search cost me a quarter of an hour, but the tic-tac was finally discovered in great perfection.—(Op. Cit.)—*Tr.*

tively establishing it until the full term has expired. Its presence, on the other hand, is the most certain sign of pregnancy. If it should be manifestly present in two points distant from each other, it would render probable the existence of a double pregnancy, particularly if the number of beats was always different on the right and left sides. The clearness, force, and regularity of the beats announce that the fœtus is in good health; their variation, weakness, and intermission, that it is either suffering or diseased; finally, the increase of these disturbances, and the complete cessation of the double sound, are indications that the child has ceased to live.

END OF AUSCULTATION.

PART II.

PERCUSSION.

THE origin of percussion may be traced to the earliest antiquity. It is exceedingly probable that Hippocrates employed it to diagnosticate tympanites.* Aretæus certainly speaks of it, when he says: Nam si, præ inflatione, quum verberantur, tympanum quodam modo referant, τυμπανιας nominantur.† Galen also employed it to distinguish the tympanitis of ascites and œdema of the abdominal walls.‡ Actuarius also describes percussion in speaking of the same disease.§ Paulus of Ægina goes further, and notices the reso-

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* Aphorisms, sect. iv., aph. II.—Coac. 491, 496.

† De signis et caus. diut. morb., lib. II. cap. I. de hydrope; Ed. Henr. Stephani, 1567, f. I., p. 36. A little further on he says again : " Tympanias autem . . . auditu sonorus est; nam ad palmæ percussum abdomen sonum edit."—Ibid., p. 37.

‡ "Sed ad veram notitiam comparandum pulsare cogimur abdomen ut attendamus si veluti tympanum resonet." (De dignoscendis pulsibus, lib. IV., cap. III.) Ed. Kuhn, vol. viii., p. 951.

§ " . . . . Qui, quum ægri abdomen pulsatur, tympani in morem intumescat, τυμπανιας dicitur . . . De methodo med., lib. I. cap. XXI. Ed. Step., vol. ii., p. 164. G.

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nance of the superior part of the belly, in peritoneal
pneumatosis,* and that of the inferior part in uterine
tympanites.†

At a period nearer our own times, percussion seems
frequently to have been employed in gaseous effusions.
Tagault applied it to ascites;‡ L. Rivière used it to
diagnosticate uterine dropsy§ and hypertrophy of the
spleen.|| Other authors have, also, made mention of
it. These, however, are only scattered facts and in-
complete ideas, none of which relate to the chest; nor
have they been any where collected or systematized in
such a manner as to constitute a distinct method.
Avenbrugger was the first to devote his attention es-
pecially to percussion; and he may justly be considered
as the inventor. But in spite of the treatise which he

* " In quâ (affectione) aliquandò flatûs copia cum paucissima
humiditate coacervatur, inter membranam peritonæum appelatam,
ac intestina, adeò ut si verberetur superior venter, instar tym-
pani sonum edat." De re med., lib. III. cap. XLVIII. Ed.
Steph., vol. i., p. 471. D.

† " In his sequitur tumor imi ventris, ... et ad digitorum il-
lisionem sonitus tympani oboritur." Ib., lib. III., cap. LXX.,
de inflatione uteri. Ed. Steph., vol. i., p. 487. B.

‡ La tumeur aqueuse ne sonne comme vent, mais comme
eau." Chir. de J. Tagault, Lyon, 1580, p. 143, d'après M. Pigné.

§ "Si à flatibus (uteri hydrops,) excitetur, imus venter per-
cussis sonitum edit. . . . Si verò ab humore seroso fiat, gravitas
major adest in parte, et sonus veluti fluctuantis aquæ." Riverii
opera med. omnia, cap. XII., p. 391. Geneva, 1737.

|| ". . . A tumore flatuoso distinguitur qui murmur ac sonum
edit, qui in scirrho (lienis) non reperiuntur." Ibid., cap. IV.,
p. 333.

published in 1761,* his discovery passed almost un-
noticed, and percussion speedily sank into oblivion.

Corvisart deserves the credit of having revived and
extended its use in France. But *immediate* percus-
sion, as then practised, was not without its inconve-
niencies; its application was restricted, and its results
had not always the desired exactitude. It had not yet
reached perfection, and it is to Piorry that science is
indebted for its consummation. Thanks to a happy
modification, percussion rendered *mediate*, has been of
much more frequent application, and its results have
become much more exact. At the same time, Piorry
defined its value by numerous experiments upon the
dead body; he laid down its rules with extreme care,
and gave it a wider field, in applying it to a number
of cases where it had been as yet unused. From that
time, the use of percussion has every day become more
popular, and this method now constitutes with auscul-
tation the most solid basis of a correct diagnosis.

GENERAL RULES.

In order that percussion may furnish sure and use-
ful results, the observance of several general rules is
necessary. The physician should, first of all, choose
a convenient position: he may usually place himself
indifferently on the right or left hand of the patient:
it is important that his position should not be con-

* Inventum novum ex percussione thoracis humani, etc. Vi-
enna.

strained, and that he should be able to strike the different regions about to be explored, at a right angle and with equal force; the points upon which he strikes, should not be too near or too far from himself; too great a difference in the distance of these points produces difference in the results. Moreover, if the results of his exploration appear doubtful, he may pass alternately from left to right, repeating each time the examination in these varied positions. It often happens that by means of this test we confirm a doubtful opinion, or correct a previously erroneous judgment.

Percussion may be *immediate*, that is to say, it may be practised directly over the parts, the degree of whose resonance we wish to appreciate. In this case, we percuss with the extremities of the four fingers placed in contact with each other, on the same level, and straightened, or rather, slightly bent, so as to make more or less of a *right angle* with the metacarpal bones, but always retained in close connexion with each other; we may also percuss with the flat of the hand, or sometimes even with tip of the stethoscope, if we wish only to obtain rapidly an idea of the general resonance of the chest before proceeding to a more regular and complete exploration. This method of exploration has many disadvantages; generally speaking, the sound that is produced in parts thus struck, is obscure, and ill-defined; in order to obtain it more distinct and clear, we are obliged to employ a certain degree of violence, and percussion then becomes painful to the patient, particularly if it is performed over

inflamed parts; over the mammæ it is not at all prac-
ticable; it is also difficult in fat persons, whose tho-
racic walls are very thick, and in dropsical subjects,
whose sub-cutaneous cellular tissue is infiltrated with
serosity; it is less practicable also over the belly,
which does not offer the same elastic resistance as the
thorax. Percussion is even not without some danger;
direct and incautious shocks may produce a serious
concussion in the parts struck, and, if they are too vio-
lent, may cause, for instance, the rupture of a cyst or
an aneurismal tumour.

But this is not all the disadvantage: immediate
percussion, when hastily practised on the walls of
the chest, enables us to obtain a superficial idea of its
general resonance, and this method of proceeding
will, perhaps, answer to establish a very evident al-
teration of sound, or to recognise a very extensive
lesion; but it will allow slighter modifications to pass
unnoticed, and cause us to overlook very limited lesions.

If, then, we are sometimes obliged to content our-
selves with immediate and rapid percussion, in cases
where the weakness of the patient forbids a lengthy
examination, we should, at all times, when it is pos-
sible to make a choice, prefer *mediate percussion.*

This consists in interposing a substance of a diffe-
rent nature, between the hand which strikes, and the
part struck. This method of procedure has an incon-
testable superiority over the preceding. The sounds
produced by it are clearer and more distinct; there is
not the same degree of violence necessary to obtain

them, and the intermediate substance lessens the shock of the striking hand; mediate percussion is consequently much less painful, may be prolonged more readily, and practised without danger over sensitive and delicate regions, and becomes applicable in cases where direct percussion could not be used; it enables us to distinguish less decided and less extensive lesions; it furnishes the means of circumscribing diseased organs, judging of their figure and following them, so to speak, in the material changes that their volume undergoes; finally, by the greater or less resistance that the finger experiences, it may also give an idea of the different degrees of their density.

In mediate percussion, the substance interposed may be, either the pleximeter of Piorry, a piece of India-rubber, or the finger of the observer. The pleximeter (πλησσω, I strike, and μετρον, a measure,) is a flat, thin piece of ivory, either circular or oval, smooth on both sides, finished on the two opposite ends of its long diameter, with vertical plates or prominences, designed to steady it.* It is very convenient for percussion of the abdomen, and upon the chests of fat persons which present a regular surface, but offers less advantages

* For the very numerous modifications which the pleximeter has undergone, for its graduation, for the different instruments designed to take the place of the finger in percussing, &c., consult the works of M. Piorry, (De la percussion médiate, &c., 1828. Du procédé opératoire a suivre dans l'exploration des organes par la percussion, &c., 1831,) and the treatise by M. Maillot, one of his best pupils. (Traité Pratique de Percussion, etc., 1843.)

for examining a patient whose thorax is much ema-
ciated: it is not easy to apply it accurately in the de-
pressed intercostal spaces, without causing some pain,
and the peculiar resonance of the ivory, when struck,
mingling with the sounds produced by the internal or-
gans, may alter its clearness.* In order to avoid
these inconveniences, it has been proposed to use a
flat piece of India-rubber, which may be applied more
accurately and without pain, but with which it is dif-
ficult to obtain much sound. *Digital* percussion then
seems to us to be preferable: the finger, composed of
both hard and soft parts, resembles in its structure
that of the thoracic walls, and causes less alteration
in the sounds which they yield; pressure, in cases in
which it becomes necessary, is attended with less pain;

* The following are the rules laid down by M. Piorry for the
employment of the pleximeter: the instrument should be held
firmly fixed between the thumb and fore-finger of the left hand,
and very accurately applied over the parts, *in order, as it were,
to identify itself with them.* " When we wish to obtain much
sound from an organ, the fingers which strike ought to be held in
the following manner: the fore and middle finger should be ac-
curately applied one upon the other, bending the middle finger
rather more on account of its greater length, in order that its ex-
tremity may not extend beyond that of the fore-finger. The
thumb is then firmly supported against the articulations of the
second and third phalanges of the fore-finger. These three fin-
gers, thus united, form a very solid whole, whose surface of per-
cussion, if we bend the middle finger a little, has the extent of
the pulp of the fore-finger alone. It presents the size of the ex-
tremity of the two fingers united, if we hold them on the same
level. (Du procédé opératoire, &c., p. 44.)

being thin and slender, it is easily placed in the inter-
costal spaces, or upon the depressed portions: it is so
flexible, that it easily accommodates itself to the salient
or even to the rounded parts; and being also the or-
gan of touch, it adds the tactile perceptions to those
of the ear. Finally, and this is a consideration of no
small value, it is always at the disposition of the phy-
sician, who might be placed in an embarrassing situa-
tion by the loss of his pleximeter.

It is upon the index, but still better upon the mid-
dle finger, that percussion is generally made, and it is
always placed in *pronation*. In some rare cases, it is
more convenient, in consequence of the position of the
patient, to strike upon the *palmar* surface of the fin-
ger, turned in *supination*. The method of proceed-
ing is generally as follows: the left hand* is applied
with its whole surface over the region whose reso-
nance we wish to examine, and held there firmly; the
middle finger is separated from the others, and then
being well extended, it adapts itself accurately to the
subjacent parts, pressing lightly, if they are painful,
or we wish to examine a superficial organ, and more
strongly, if there is no pain, or we wish to explore
deep-seated organs. The movements of the right
hand, in the act of percussing, should never arise from
the shoulder, or even the elbow, but entirely from the

* It is rarely that we see a person sufficiently ambidextrous
to perform the same operation with either hand. It is better,
therefore, to pass to the other side of the patient, as before-men-
tioned, if percussion presents any difficulty in this position.

wrist: they are thus more accurately measured, more regular, and much less painful to the patient, at the same time that the sounds produced are clearer. If we wish to strike with considerable force, in consequence either of the thickness of the thoracic or abdominal walls, or the depth at which the viscera are seated, and if the absence of pain permits a more energetic blow, we use three fingers closely applied to each other, and bent to a right angle. Two fingers will suffice if we desire less force; and if the parts struck are exceedingly painful, or the organ which they cover, superficial, light percussion with the middle finger alone will give sufficient results.

Generally speaking, we ought to accustom ourselves to strike with gentleness; besides the advantage of being less painful, this method of proceeding possesses that of preserving the internal sounds in all their clearness. In every case percussion should be moderate at first, so that the patient may become accustomed to it; it may afterwards be practised with increasing force until we arrive at that degree which furnishes the best results. This *light* or *forcible* percussion is besides demanded by the different situation either of the organs in relation to each other, or the varying seat of the lesion in them.*

* Maillot, following the precepts of Piorry, uses this language on the subject: "Light percussion will enable us to examine the superficial strata of the lung; by rendering it gradually more forcible, we will be enabled to judge of the density of the lungs at different depths." Loc. cit. p. 75.

The hand used in percussing should be raised and lowered alternately and strike perpendicularly, in some cases, several successive blows separated by very short intervals; in others, only *one*, quick and smart; after which the finger should be immediately withdrawn; sometimes, on the other hand, we allow it to remain several seconds in contact with the part, with the view of arresting the sonorous vibrations, and, consequently, enabling us better to judge of the degree of resistance and density of the subjacent organs.

Sometimes we begin by percussing the central part of the region that corresponds with the affected organ. At other times it is more advantageous to explore, first, the surrounding parts, and gradually approach the diseased viscus. In this manner, the contrast between the healthy and the diseased parts is more evident, and the ear more readily detects the slightest difference of sound, which immediately gives evidence of a material alteration, even although slightly marked. Sometimes it is advisable to mark by lines either of nitrate of silver, or rather of ink, the points where the lesions commence and to bound the affected organ. This accurate circumscription, constantly practised by Piorry, enables one to follow, as it were, step by step, the increasing or decreasing progress of the disease, and it may, consequently, be the source of valuable prognostic and therapeutic indications.

Besides the general directions that have been given for the physician who practises percussion, there are a few rules which it will be well to observe as regards

the patient. The region to be examined should be bare, or covered only with light clothing: silk and worsted stuffs should be forbidden on account of the sounds produced by their friction.

The position of the patient should be in general erect, varying according to the region percussed. Sometimes it may be necessary even to vary it during the examination; if we wish, for instance, to detect the presence of a liquid effusion into the pleura, or more particularly into the peritoneum, the trunk should be inclined in different directions, in order to change the position of the fluid in the dependent parts.*

DIVISION.

Percussion is applied particularly to the *chest* and *abdomen;* and in a few instances to the *head, neck,* and *extremities*.

Sect. I.—Percussion of the Chest.

Percussion of the chest includes the examination both of the *pulmonary* and *circulatory apparatus*.

* It is unnecessary to add, that in *percussion*, as in *auscultation*, the observance of strict silence around the examiner is necessary throughout the whole operation.

CHAPTER I.

PULMONARY APPARATUS.

I. *Special Rules.*

In percussion of the anterior parts of the chest the patient may remain standing; but as the body has no support in this position, it is better that he should be seated with his back supported. In either case, the arms should hang easily by the sides, the shoulders be relaxed, and the head held erect. But it is preferable that he should lie upon his back, in a more or less horizontal direction, according to the degree of dyspnœa; the thorax thus rests upon a resisting plane, the arms are placed by the side of the body, and, by throwing the shoulders back a little, so as to put the muscles slightly upon the stretch, we endeavour to give the trunk a perfectly symmetrical position. In examining the right or left subclavicular region, the head should be inclined alternately to the opposite side from that examined.

In order that percussion may be practised on the lateral parts of the chest, the patient should be seated on a chair, or lie on the opposite side to that about to be examined, raise his hands and clasp them over his head, or have them supported by an assistant.

If we wish to examine the posterior parts of the chest, the position, with the arms crossed, is not so good as the sitting posture, either on a chair or the bed, with the head bent forward; the back should be bent, and the arms folded, so that the muscles may be put upon the stretch, and the scapulæ separated from the spine and fixed upon the thorax, with the greatest firmness and exactness. In some rare cases, it is necessary to place the patient on his hands and knees, in order to convince ourselves whether the dulness is moveable, or whether it is owing to the presence of a liquid capable of displacement.

There is one rule, whose observance is of great importance; it is this, that the two sides of the chest, between which the comparison is to be made, should be struck in precisely the same manner; and to this end the percussion should be performed in turn upon the right and left sides, at points exactly corresponding, with an equal degree of force, and during both inspiration and expiration.

II. *Physiological Phenomena.*

Percussion, when practised on the different regions of the thorax, gives very different sounds; a due acquaintance with these varieties of the normal condition, is of great importance in the appreciation of the different modifications which take place in the pathological state.

It is difficult to describe by *word* the natural resonance of a healthy chest; it is a clear sound, *sui gene-*

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ris, (*pulmonary* of Piorry,) which ought to be well
studied previously, either by percussion on the dead
body, or, what is better, on healthy individuals, in
order that the student may easily accustom himself to
recognise the different variations.   We learn by expe-
rience that the sound varies in proportion to the diffe-
rent degrees of thickness of the thoracic walls.   *In
front*, it is clear above the clavicle, for a short dis-
tance, and upon this bone itself; clear and still more
distinct in the sub-clavicular region, from the clavicle
to the fourth rib exclusively; it loses a little of its
clearness, particularly in fat persons, on a level with
the nipple.   *On the left side*, it is obscure at the pre-
cordial region,* and a little lower, we again find the
pulmonary sound as far as the neighbourhood of the
seventh rib, at which point it gives place to the tym-
panitic resonance caused by the presence of the great
end of the stomach.   *On the right*, it is clear from the
top of the thorax to the base, that is, to the level of
the sixth or seventh ribs; after leaving this point, it
begins to be replaced more and more by the dulness
produced by the presence of the liver.   The median
portion of the anterior wall of the thorax, in other
words, the sternal region, gives a clear sound at its
superior part, less so, however, than the sub-clavicular,
and as it approaches the level of the third rib, it be-
comes duller as far as the xiphoid cartilage.

Laterally, in the space bounded on either side by
a vertical line, let fall from the anterior and posterior

* See Percussion of the Heart.

edges of the axilla, the pulmonary resonance is very great, extending from the hollow of the axilla to the fifth, sixth, or seventh rib inferiorly.

Posteriorly, the resonance is present from the top to the bottom of the inter-scapular space; but it is only slight, and ceases at the level of the second or third false rib. More outwardly, in the space bounded exteriorly by a vertical line let fall from the posterior edge of the axilla, is the supra-spinous portion, where the pulmonary resonance is very obscure, in consequence of the thickness of the thoracic parietes, and the *infra-spinous* portion, where the dulness is rather less. Happily, it is easy at these points to distinguish the normal elasticity from the resistance that true pathological dulness presents by forcible percussion. Lower down in the space corresponding with the angle of the ribs, the resonance of the lung reappears with all its clearness: a short distance below, it is replaced on the right side by the dulness of the liver, and on the left, by that of the spleen. This inferior boundary is generally rather higher on the right side, in consequence of the diaphragm being pushed up by the liver; sometimes on the left side the pulmonary sound gives place to the tympanic resonance produced by the distention of the stomach with gas.

Independently of these varieties presented by the pulmonary sound in the various parts of the chest over which percussion is made, there are some which depend on the age of the individual and the physical conformation of the chest. Thus, the resonance is

rather greater in some old persons whose chests are emaciated; it is much more marked, and comparatively tympanitic in very young subjects, but in them this excessive resonance is well explained by the slightness of the muscular investment. Generally, also, the resonance is greater in proportion as the chest is larger, and the walls thinner; and it is less as the chest is narrower, and its walls thicker, in consequence of the development of the muscles, or the deposition of fat. We should not forget, either, that in rachitic deformity the resonance is generally less, in consequence of the long-continued mechanical compression of the lungs, and the thickening of the bony frame-work of the thorax. We have often witnessed these extensive alterations of the pulmonary parenchyma, and osseous tissue in children who have perished in the advancing stages of rachitis.

III. *Pathological Phenomena.*

In the diseased state, the sounds rendered by the chest in parts corresponding to the lungs, may present numerous varieties of degree and character; sometimes they become clearer and more intense, sometimes duller and less clear; at other times again they are characterized by a *peculiar* tone.

A. *Increase of resonance* manifests itself in two principal forms: in the first variety the exaggerated sound obtained by percussion retains the character of the natural resonance of the chest, (clear sound;) in

the higher form it assumes a resonance analogous to that of the left hypochondrium, when the stomach is distended by gas, (the tympanic sound.)

a. The *clear sound* may be more or less marked; it may be general or partial, heard over the whole surface of the thorax, or confined to a circumscribed region on one or both sides of the thorax.

As the resonance varies much in the healthy subject, it is not always easy to say in such an individual, whether it is really exaggerated, particularly when the chest is every where resonant: we must then take into consideration the conformation of the thorax, and regard its size compared with the degree of development of the soft parts. When the exaggeration of sound is partial, it is easier to establish it. When, however, it exists on both sides in corresponding points, we may then doubt its reality, and should, under the circumstances, remember the relative differences that we have described as belonging to each region. Finally, when it occurs only in one half the chest, we might sometimes mistake the side, pathologically more sonorous, for that whose resonance is normal, and inversely, believe that the natural sound of the healthy side is diminished by a morbid condition. We should then examine whether there is at the same time prominence, which side is most normally formed, and which expands most regularly; and sometimes even it is well to auscult both sides in order to decide this question by their comparison.

A simple exaggeration of resonance may, as we

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have seen above, exist independently of any lesion of the organs contained in the thoracic cavity, and be the effect merely of emaciation. Sometimes also it is an indication of lesions of the walls or subjacent viscera: we meet with it in *hernia of the lung* and *subcutaneous emphysema;* but much more frequently it is dependent upon the *different forms of pulmonary emphysema.* It has been established also (as described by Dr. Skoda) in certain cases of *pleuritic effusion above the level of the fluid.* It is owing, much more rarely, to the existence of a *pulmonary cavity* or to *dilatation of the bronchi.*

When exaggerated resonance is only the result of *emaciation,* it shows itself every where with the degrees of relative intensity that we have assigned to the different regions of the chest in the normal condition; the intercostal spaces are depressed, the clavicles are prominent, but the chest preserves its regular conformation.

Emphysema of the walls of the chest is better discovered by tumefaction of the soft parts, and particularly by the *peculiar* crepitation heard upon pressure with the fingers than by the use of the pleximeter.

Hernia of the lungs, without division of the integuments of the chest is very rare; it may, however, be met with; and if a soft, elastic tumour appear at any part of the chest, rendering a clear sound on percussion, we cannot mistake pulmonary hernia.

In *emphysema of the lung,* the excess of sound may be general, and extended over the whole chest; but it

is seldom that the resonance does not predominate in one point or other of the thorax; that it is not more decided, for instance, on a level with the costal cartilages, or else more marked in a part or the whole of one side, than in the other. Besides, under these circumstances, the form of the chest itself is changed; it bulges more than in the natural state; the intercostal spaces are often elevated, and the clavicles very slightly prominent. In partial emphysema, the excess of resonance usually coincides with more or less appreciable prominence, particularly at the anterior part of the thorax. In addition, when the emphysema is considerable, the precordial region itself is often very resonant, in consequence of the heart being covered by the anterior border of the left lung; and the inferior limit of this exaggerated resonance descends lower than normally, in consequence of the displacement of the diaphragm.

The resonance of the chest is rarely increased in the region of a *pulmonary excavation*. To produce this result, the cavities must be large, filled only with air, and the surrounding tissues must retain their flexibility, but we rarely find all these conditions united; besides, even in this case, it is not simple exaggeration of the ordinary pulmonary resonance; the character of the sound obtained is different, and is remarkable rather for its clearness than its intensity, frequently resembling more the sound produced by striking an empty vessel. The most characteristic mark of the clear sound belonging to cavities is, that it is circumscribed to a limited ex-

tent, and that it is generally met with below the clavicle.

Exaggerated resonance is an equally rare occurrence in *dilatation of the bronchi*, this lesion being most generally accompanied by increase in the density of the pulmonary parenchyma.

Finally, the exaggerated resonance that we some-times meet with in *pleuritic effusion*, is distinguished by the fact that it has its seat under the clavicle and above the level of the liquid, and that lower down it gives place to a more or less decided dulness.

b. Tympanitic sound of the chest is in every respect analogous to that produced by percussion of the left hypochondrium, when the stomach is distended by gas. This resonance generally has its seat only on one side of the chest; it sometimes extends throughout one half, and usually occupies a more or less considerable part of it. Frequently it appears in an abrupt manner, at the same time with a dilatation of the walls of the chest on the corresponding side; it rarely retains the extent which it first occupied, but its limits are usually rapidly established.

This unusual resonance indicates a *gaseous effusion into the pleura*. Its intensity is in proportion to the quantity of gas effused, and indicates the amount of compression that the lung has undergone, and the ex-tent over which it is perceived is in accordance with the space occupied by the elastic fluid.

The tympanitic sound rarely extends over the whole side, because pneumo-thorax generally supervenes in

phthisical subjects, in whom the lung has contracted adhesions to the apex of the chest. At the commencement of this pathological condition the phenomenon is perceptible, even at the base of the thorax, and as this morbid resonance has much analogy with the normal tympanitic sound of the stomach, we might sometimes commit the error of suspecting pneumo-thorax, when, in a tuberculous subject, the stomach, distended with gases, pushes up the diaphragm towards the superior part of the chest; but auscultation will remove every doubt. Besides, the introduction of air into the pleura soon gives rise to inflammation of, and liquid effusion into, this membrane, which manifests itself by a greater or less dulness.

Auscultation will also assist the physician in cases of differential diagnosis, which are sometimes so perplexing; as, for instance, when gaseous effusions are formed slowly and in small quantity in the pleural cavity, without the simultaneous development of severe functional symptoms, but which manifesting themselves by a slightly marked tympanitic resonance, we might be led to believe that the exaggerated resonance was produced entirely by pulmonary emphysema.

B. *Diminution of the resonance* of the chest may also present different degrees of intensity: we distinguish generally two varieties, namely, the *obscure* and the *dull* sound.

a. The sound is said to be *obscure* when there is still a certain degree of resonance; and, in this case, the resistance to the finger is generally slightly marked.

This obscurity of sound may also be met with, inde-
pendently of any morbid condition, and be produced
by a considerable development of the muscles, or a
thick deposition of fat. We discover that this pheno-
menon is not pathological, from the fact, that it is pre-
sent on both sides, is equal in corresponding points,
and offers in the different regions of the chest, the
degrees of relative intensity that we have indicated.

Obscurity of sound is frequently observed in certain
morbid conditions, either of the thoracic parietes, the
pleura, or the lungs.

It has been witnessed, in a slightly marked degree,
in cases of *infiltration of the walls of the chest*, but
this lesion is better revealed by the pitting of the sur-
face.   The *development of an abscess in the walls*
may also give rise to an obscure sound limited to a
circumscribed tumour. In some patients, affected
with intense *pleurodynia*, the pulmonary sound seemed
to be diminished, and this diminution appeared to us
to be dependent on a want of tension in the muscles
of the parietes of the chest, and the imperfect expan-
sion of the affected side.

Obscure sound is much more frequently connected
with deeper seated lesions. It frequently exists in
pleurisy, either in the earlier stages of this inflamma-
tion, when it has produced a slight liquid effusion into
the pleura, particularly if the partial adhesions of the
two membranes allow this liquid to re-ascend in the
form of a thin layer, or later in the disease when the
pleuræ are covered with thick false membranes infil-

trated with serosity; or even later still, when the lung having been for a long time compressed and enveloped by false membranes, cannot return to its former volume, and the walls of the chest have become depressed. Sometimes, also, the diminution of resonance may depend on a *slight hydrothorax*. In all these cases, it is most commonly seated at the base of the chest. In simple hydrothorax it (the obscurity) changes its position with that of the patient; this displacement is, on the contrary, difficult or impossible in the other affection of the pleura about to be mentioned.

Finally, we discover obscurity of sound at all times when the pulmonary parenchyma has lost its lightness and become more dense; as, in commencing *pneumonia*, in *hypostatic engorgement*, in *phthisis*, and in *serous or sanguineous infiltration of the pulmonary tissue*, (*apoplexy* or *œdema*,) following either *dilatation of the bronchi*, or the development of various morbid productions, such as *cancer* and *melanosis*.

In all these cases, the dulness is stationary, and presents no particular characteristic which can serve as a differential diagnostic; nevertheless, in pulmonary hypostatic congestion, it is generally posteriorly, and at the base of the lung, that the diminished resonance occurs: the same thing generally occurs also in pneumonia. In phthisis, on the contrary, it is commonly at the summit of the chest, either posteriorly or under the clavicles, that the obscurity is observed. In the other affections, the seat of the obscure sound has nothing special, and we must have recourse to other means in order to establish the diagnosis.

b. The sound is said to be *dull* when it resembles that produced by striking the thigh (instar percussi femoris.) It may vary in seat and extent, occupying sometimes all one side of the chest, or, on the other hand, be circumscribed to a limited space. It is, in general, accompanied by a more or less perceptible resistance to the finger.

The dulness may depend either upon considerable induration of the lung, such as that produced by a collection of tubercles, or pneumonia in the stage of hepatization, or a condensation of its tissue, by the presence of an extensive effusion of serosity, blood, or pus; more rarely, indeed, it is due to tumours developed in the walls of the thorax, in the pleura, or situated more deeply and in contact with the ribs.

In regard to *tumours of the walls*, the dull sound informs us only whether they are solid or liquid; but palpation and other methods of examination are indispensable to determine their nature. As to more deeply seated tumours, they give rise generally to circumscribed dulness, which only serves to point out their seat. It announces the existence of a dense and compact body in the subjacent region; but it does not enable us to say precisely whether it be an aneurism or a cancerous tumour, and the assistance of other means of exploration then becomes necessary.

Can we distinguish whether the dull sound is attributable to extensive effusion, or induration of the pulmonary parenchyma? Generally, in pleural effusion, the dulness is more complete; it ordinarily has

its maximum at the base of the chest, and diminishes little by little, in proportion as we percuss towards the summit of the thorax. It disappears at a varying distance from the summit, at a more elevated level posteriorly than anteriorly, or else if it reaches the clavicle, the extent itself, in connexion with its intensity, becomes an indication of effusion. Another sign of these extensive collections of liquid, is the displacement of the heart, which may be pushed behind the sternum, and even under the false ribs of the right side, if the effusion has occurred in the left pleura. But this is not all: in the case of partial effusion, it is sometimes possible, by changing the position of the patient, to produce a change of position in the dulness. This mobility is, besides, much less evident in *pleurisy* than in simple *hydrothorax*, an affection in which no false membrane, or adhesion, can prevent the liquid from obeying the laws of gravity.

If, on the contrary, it is produced by *induration of the lung*, the dulness will be fixed and immovable, whatever may be the position of the patient. In general, also, it is less intense, and its seat rarely occupies the whole side of the chest; it is usually bounded by a varying limit, being well marked in one point, and gradually diminishing as we leave this centre, so as to be blended on its limits with the natural resonance.

If the dulness is due to *pulmonary hepatization*, it will occur, on one side, along the posterior and in-

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ferior border of the lung, more rarely at the top, and scarcely ever entirely in front.

In *tubercles*, on the other hand, its general seat is at the summit, either posteriorly or anteriorly, often on both sides at once; and it will extend, diminishing in intensity, even as far as the middle portion, but rarely to the base, at least when there is no complication with chronic pleurisy.

In order to make out our diagnosis with certainty at all times, we ought not to confine ourselves to the results of percussion alone; we should study with care the results furnished by the other methods of examination, and not decide until we have compared them with the functional signs and the indications drawn from the progress of the disease.

C. Besides the greater or less modifications of pulmonary sound that we have examined, there is still another variety of resonance which should be mentioned.

We have seen above, that at the summit of the chest anteriorly, we frequently meet with a *clear hollow sound*, circumscribed to a small space, and depending on the presence of a *superficial cavity* containing only air. This clear sound is rarely analogous to the true tympanitic sound of pneumothorax, and only resembles it, when the excavations are very large. In cases where the cavity contains, at the same time, *air* and *liquids*, it assumes a peculiar metallic character (the hydroaeric sound.) This sound may also be observed in pneumo-hydrothorax, at the

point of contact, between the gas and liquid, and even, according to Piorry, in simple hydrothorax, if the pleural cavity is in the neighbourhood of an organ distended with gas, as the stomach or intestines. Finally, we sometimes produce by percussing the sub-clavicular region, a clear sound, accompanied by a slight, peculiar clacking, giving rise to a sound similar to that rendered by striking a cracked vessel with the finger, and which has received the name of the *cracked-pot sound*.

In order to produce the last phenomenon distinctly, we must, generally, strike with one finger only, at the same time requesting the patient to hold his mouth open. In the greater majority of cases, it announces the presence of a *pulmonary cavity*, most frequently tuberculous; but it is not invariably present, and in order to obtain it, the excavation must have a decided extent, should be rather superficially seated, have thin and elastic walls, and, above all, contain both air and liquids.

SIGNS DISCOVERED BY PERCUSSION.

Name of the Sign.	Physical Cause of the Sign.	Ordinary seat of the Sign.	Diseases in which it is observed.
Increased resonance.	Diminished density of the subjacent parts, and increased proportion of air within the chest.	Variable, may extend over the whole chest, or the superior regions anteriorly and laterally.	Pneumothorax. Hydro pneumothorax, upper part of the chest. Atrophy of lung. Emphysema of lung, or walls of chest. Emaciation of walls of chest. Pleurisy with effusion above the level of the liquid (Skoda.) Hernia of the lung without division of the integuments. Dilatation of the bronchi, [rare.]
Tympanitic resonance.	Unnaturally abundant quantity of air in the subjacent parts, together with increased tension of the walls.	Left infra-clavicular and mammary regions; also axillary and infra-axillary on either side.	Pulmonary emphysema { Atrophous, Hypertrophous. Pneumothorax. Hydro-pneumothorax.
Diminution of resonance. a. [Obscure sound.]	Intervention of some substance between the lung and the walls of the chest, which prevents the transmission of sound.	All regions of the chest.	Great muscular development, thick layer of fat, [when occurring under these circumstances, it may be recognised from the fact of its being equal in corresponding points on opposite sides]. Infiltration of the walls of the chest, abscess in the thoracic walls. Pleurisy, in early stages, with slight effusions, or later, with plastic exudation, or retraction of the walls of the chest; slight hydrothorax.

Diminution of resonance. b. [Dull sound] with increased resistance of walls.	Increased density of the subjacent parts, and diminished quantity of air in the corresponding pulmonary tissue.	All the regions of the chest but the bases and summits anteriorly and posteriorly, more frequently than the central and lateral region.	Pneumonia, acute and chronic, former in all its stages. Tuberculous disease in all its stages. Dilatation of the bronchi. Tumours of walls of chest, or pleura, cancer melanosis, [rare.] Pleuritic effusion. Hydrothorax. Pulmonary apoplexy. Hæmothorax. Condensation of the lung from the effusion of serum, blood or pus. Hydro-pneumothorax, [lower part of the chest.]
Tubular character of sound.	Any condition which brings the larger bronchi unnaturally near the surface, and so within reach of percussion; or the presence of a solid substance between those bronchi and the surface.	Lower part of infra clavicular and upper part of mammary regions; most frequently observed on the left side.	Pleuritic effusion. { General [period of retraction.] { Partial. Accumulation of pus retained and lying over bronchi. Pneumonia [very rare.] Dilatation of bronchi. Tuberculous cavity of a small [rarely large] size. Chronic consolidation of lung. Cancerous mass around bronchi.
Amphoric character.		Anterior superior part of chest on either side.	Tuberculous cavity of a large size, having walls generally and equally condensed.
Cracked metal sound. [Cracked pot of B. and R.]	Sudden propulsion of air, [forcibly expelled from a cavity] against the walls of the passages with which it comes in contact.	Anterior superior part of chest on either side.	Tuberculous cavity of large size, with anfractuous walls, and communicating freely with the bronchi; with thin and elastic walls, and containing air and liquids.
Moveableness of the limits of dulness of sound.	Moveableness of the material causing the dull sound.	Inferior regions of the chest.	Pleurisy, especially at the period of gravitating effusion. Hydrothorax. Hydro-pneumothorax.

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CHAPTER II.

CIRCULATORY APPARATUS.

PERCUSSION OF THE HEART AND GREAT VESSELS.

I. *Particular Rules.*

THE majority of the rules we have laid down as applicable to percussion of the pulmonary apparatus, may be repeated here. In general, moderate percussion is sufficient to discover that portion of the heart which is in immediate contact with the walls of the chest; but in order that we may have a just idea of the real volume of this organ, and discover the part concealed under the anterior border of the lung, it is necessary that the percussion should be deep and practised with more force.

It will be necessary also always to percuss first in the vertical direction, and then in the horizontal; often also it is useful to determine even more exactly the limits of the dulness in every direction; and in order that we may have more accurate results, and be able to judge of the changes which may take place from day to day, it is advisable to mark them by lines upon the body.

II. *Physiological Phenomena.*

In the normal condition the præcordial region gives a dull sound, the degree and extent of which are by no means invariable. In fact, the heart being more or less covered by the anterior border of the left lung, necessarily gives rise to great variations in the pleximetrical results. However, according to the measurements generally admitted, the normal dulness of the precordial region extends about two inches in every direction. It begins, superiorly, about the fourth rib, and extends downwards as far as the sixth; it has its maximum about the centre of this region, and laterally it is blended by degrees with the pulmonary sound. Below, and on the left, it is replaced by the peculiar resonance of the stomach. Below, and towards the right side, it is often confounded with the dulness of the left border of the liver, which approaches or touches the heart, so that it is difficult to define exactly the limit which divides these two viscera.

The dulness yielded by moderate percussion of the præcordial region, does not give, (as before stated,) the real dimensions of the heart; it merely makes known the extent of surface in contact with the walls of the chest. Stronger and deeper percussion is necessary to discover the parts concealed by the lung, and the obscure sound then extends laterally, beyond the limits before mentioned, over a space which varies

in proportion to the different sizes of the heart at different ages and in different individuals.

In regard to the *great vessels* arising from the heart, we have already seen that their presence behind the sternum slightly modifies the resonance of the chest; and, according to the recent researches of Piorry,* will produce an obscure sound, quite distinct from the pulmonary resonance. This slight dulness extends over a space of from sixteen to twenty lines, near the base of the heart, at the point where the aorta and pulmonary artery are in contact with each other, and over not more than ten or twelve lines where the aorta rises alone behind the sternal wall.

III. *Pathological Phenomena.*

The dulness yielded by the precordial region in the natural condition, may, in a morbid state, be diminished in intensity and extent, and even give place to *excessive resonance.* But this phenomenon is nearly always due to emphysema of the internal edge of the lung which covers the anterior face of the heart; it more rarely accompanies atrophy of this viscus, which also allows the internal edges of the two lungs to approach each other. More rarely still, the excessive resonance depends directly upon a lesion of the central organ of the circulation, namely, the accumula-

* De l'examen plessimétrique de l'aorte, etc., dans Arch. Gén. de Méd., December, 1840.

tion of gas in the cavity of the pericardium: in fact, pneumo-pericardium is an exceedingly rare affection. In some cases, no less rare, the sound by a *hydroaeric tone* announces the existence of a collection of liquid and gas in the cavity of the serous membrane.

The modifications of resonance, which are influenced by pathological conditions of the central circulatory apparatus, consist much more frequently of an *increase of the natural obscurity* of the precordial region; this latter is converted into a *dulness* at the same time more decided and extensive, with a proportionate increase of resistance to the finger. These phenomena may depend either upon the presence of *large clots* in the cavities of the heart; more frequently upon *eccentric hypertrophy* of this organ, or upon *liquid effusion into the pericardium* composed of serosity with or without false membranes, (hydropericarditis, pericarditis,) with or without the mixture of a variable quantity of blood, (hemorrhagic pericarditis,) or again, by a combination of several of these morbid conditions.

Some peculiar characteristics of the dulness will serve to establish the differential diagnosis between hypertrophy of the heart and hydro-pericardium. Thus in this latter affection, the superior or lateral boundaries of the dull sound may vary according to the position of the patient; for instance, when he is in a sitting position, the transverse diameter will exceed the vertical.

This important characteristic fact should also be noticed, that, in hydro-pericardium, the dulness very

frequently comes on in a short time, and gradually increases in extent,—a progress and extent not observed in hypertrophy. We may remark also, that the space occupied by the dull sound is in proportion to the increase of volume of the heart, and may afford us a tolerably accurate measurement of it; we should recollect, however, that complication with pulmonary emphysema, so frequent in organic diseases of the circulatory apparatus, is an obstacle to the accuracy of this measurement.

According to Corvisart and Piorry, the results furnished by percussion will enable us to extend the diagnosis still further, to distinguish dilatation of the heart with atrophy, from dilatation with hypertrophy of the walls, and to recognise the alterations of any of its cavities, &c.

In some cases, a more or less decided and extensive dulness manifests itself in the course of the aorta: considered singly, this sign would be of no great value, since any variety of tumour situated behind the thoracic wall, and in the direction of this vessel, would manifest itself by the same diminution of natural resonance. An abnormal dulness, however, in the region of the sternum may announce, sometimes before any other symptom, the existence of an *aneurism of the ascending aorta*, and the examination of the other concomitant phenomena will complete this first semeiotic datum.

SECTION II.

PERCUSSION OF THE ABDOMEN.

I. *Particular Rules.*

In percussion of the abdomen, (which is generally performed upon the anterior walls,) the patient should lie upon his back in a symmetrical position, with his arms extended along his body; the thighs a little elevated and bent slightly upon the trunk, in order that the abdominal parietes may be easily depressed, and thus brought near to the deep-seated organs. Moderate relaxation is the more necessary, as too great tension of the muscles has the effect of making them resisting, and rendering the sound furnished by the subjacent viscera more obscure.

In the exploration of the lateral regions, the patient should lie on the opposite side to that about to be examined; and in the explorations of the posterior regions, he should lie upon his belly, or be in a sitting posture, with the body bent forward. It is often necessary to incline the body either to the right or left, in order to observe whether change of position produces a shifting of the dulness: it is seldom necessary to place the patient upon his hands and knees for this purpose.

As to the practitioner, he should stand on either side indifferently, and percuss in different directions, ac-

cording to the organ to be explored. If, in the examination of the different regions of the abdomen, digital percussion has the advantage of being joined to palpation, the pleximeter, on the other hand, has that of being easily shifted around the abdominal viscera, in order to measure their circumference; and if in the examination of the chest the finger generally suffices, *here* the pleximeter should sometimes be employed in preference. It will be particularly useful if the belly is very sensitive, because the pressure of the pleximeter being uniformly distributed, and over a more extended surface, it will be much less painful.

Percussion of the abdomen particularly, should be sometimes very superficial, and at others deep; and the pleximeter will serve a very useful purpose in depressing the abdominal walls, in order to study the sound of parts deeply seated in the abdomen.

II. *Physiological Phenomena.*

The various regions of the abdomen, considered in relation to its normal resonance, present very great differences, which are connected with the varying structure and density of the organs contained in its cavity. For the sake of accurate study, it is divided into three horizontal belts, which include its whole extent: 1st, the epigastric, right and left hypochondriac regions; 2d, the umbilical region, and the flanks, which correspond posteriorly with the loins; 3d, the hypogastric, and the right and left iliac regions.

At the *epigastrium* the sound is a little dull in the

superior and right portion, varying in extent, in consequence of the presence of the left lobe of the liver, which encroaches more or less upon the epigastric region. In the remaining portion of this region, which is in relation with the stomach, we obtain a clear sound, (stomachal,) which becomes *humoric* if the stomach contains gases and liquids, and more or less obscure, if it is filled with alimentary substances.

The *right hypochondrium* yields a dull sound, (*hepatic*,) which extends throughout it from the sixth or seventh rib, (five inches below the clavicle, according to Piorry,) to the edge of the false ribs, beyond which the intestinal resonance is established.

This dulness, which is rather less marked above, in consequence of the habitual interposition of a thin layer of the lung, is at its maximum in the middle of this region; lower down, as the liver diminishes in thickness, we find, by deep percussion, the clear sound of the intestines, obscured by the hepatic dulness. In a horizontal direction, the dull sound extends towards the right as far as the posterior region, and towards the left, it ceases one or two inches beyond the median line, where it is replaced by the stomachal resonance. These limits give the exact measurement of the liver in every direction. It is even possible, by strong percussion, to make an approximate estimate of its thickness, and it then becomes very easy to appreciate its size.*

* A correct knowledge of the *situation* of the liver, in relation to the neighbouring organs, is of great importance in reference to

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In the *left hypochondrium* which corresponds to the great extremity of the stomach, we obtain anteriorly a clear stomachal sound, more decided than that at the epigastrium; laterally and more posteriorly, this sound becomes dull, in consequence of the presence of the spleen at this point. The line of separation between the clear and the dull sound defines the inner limit of this viscus, and the inferior limit is determined by the line where the resistance to the finger gives place to a certain degree of elasticity, and the splenic dulness to the intestinal resonance, at least whenever the kidney is not in contact with the spleen.

The *umbilical region* yields a more or less clear sound, which is due to the presence of a portion of the arch of the colon in its superior part, and to the small intestine in the remainder of its extent (*intestinal sound.*) Laterally, towards the *lumbar region* the sound still preserves a little of its clearness, in consequence of the presence of the ascending or descending portion of the colon; but more outwardly, and throughout the lumbar region, it gives place to a dull sound extending as far as the level of the kidneys which are covered by a thick muscular layer.

In the *hypogastrium*, the presence of the lowest

the diagnosis of some of its structural lesions. It becomes highly useful in enabling us to understand how an enlarged liver may so interfere with the stomach as to interrupt its functions; how it may produce jaundice by impeding the flow of bile; dropsy of the abdomen by obstructing the return of the blood to the heart; and how abscesses, originally formed in the hepatic tissue, may burst into the surrounding organs.—(*Tr.*)

convolutions of the small intestine gives rise to a clear sound, if the bladder and uterus are empty. In the opposite condition, we obtain, in the lower portion, an invariable dulness circumscribed by a curved line convex superiorly, with humoric resonance at the boundary if it is the bladder which is distended, and immediately replaced by the clear sound, if it is the uterus which is developed by the product of conception. Finally, in the *iliac regions*, we perceive a clear sound, when the cœcum, or the iliac portion of the colon are distended by gases, a humoric sound if they contain gases and liquids, and a dull sound (*stercoral*) if they are filled with fæces.

III. *Pathological Phenomena.*

The sounds yielded by the different regions of the abdomen, present very numerous modifications in the *pathological condition.* They may be altered in their *intensity* and in their *character*, and be modified in their *seat* and *limits*, that is to say, be increased or diminished in extent, and undergo displacements in different directions. Finally, *abnormal sounds* sometimes present themselves in different parts of the abdomen, which are not usually found there, and of which not even a trace exists in health. Let us study in succession the alterations of resonance in each of the abdominal viscera separately, and then those which may present themselves in the different regions of this cavity.

Liver and *gall-bladder*.—The hepatic sound may

change its position in the same manner as the liver
itself, without any alteration either in character or ex-
tent; these displacements, generally speaking, only
take place in the vertical direction: the dulness may
rise higher than in the natural condition, to such a de-
gree, that its superior limits reach the fourth or even
the third rib: we observe this in cases where the liver
is pushed up in consequence of an extensive peritoneal
effusion, or even in those of very considerable meteo-
rism.   It may equally be more or less depressed,
below the inferior border of the false ribs, by ex-
tensive collections of liquid or gas in the left pleural
cavity.

In other circumstances, the hepatic sound occupies
a more considerable space; its superior limit rises along
the side of the chest; the inferior is at the same time
depressed a little below the border of the ribs, and de-
scends sometimes even to the crest and fossæ of the
ilium; often, again, the dulness extends equally to the
left, occupying the whole of the epigastrium and even
reaching the hypochondrium. We cannot fail then
to recognise the increase in volume of this viscus, when
the dimensions can be so readily measured by the ex-
tent of dulness on percussion, nor to judge of its shape
by the relative increase of this dulness in the vertical
or horizontal direction.

But this increase in volume of the liver is concomi-
tant of very different lesions: it may be due either to
cancerous masses developed in its thickness, to the
presence of one or more hydatid cysts, to fatty dege-

neration, or finally, to a recent sanguineous congestion, or a chronic hypertrophy without any other alteration of structure.

In establishing the differential diagnosis, palpation often lends great assistance to the use of the pleximeter.

In cases of *cancer* or *hydatid cysts*, the parts of the liver which are accessible to touch, present more or less prominent inequalities, and its inferior border is often unequally thickened. When, on the contrary, it is due to *simple hypertrophy*, or *fatty degeneration*, the viscus usually retains its shape; the part which passes beyond the false ribs is smooth, and the inferior border remains thin and sharp. But in hypertrophy the liver is generally heavier and denser, whilst in the fatty condition it is usually lighter, and in the first case, the resistance to the finger, in percussing, is greater than in the second. It should be remembered also, that the fatty condition is met with almost exclusively in tubercular phthisis. In regard to the distinction between cancer and the acephalocystic cysts, the cancerous nature of the tumours will be recognised by their number, their small size, and their central depression; acephalocysts might be suspected, if there were only a single tumour more prominent and more rounded, and there would be no doubt in the diagnosis, if we could establish by percussion a peculiar tremulousness, which will be spoken of hereafter.

At other times, the hepatic sound occupies a more narrowed space; its dimensions are diminished in every direction, and the limits circumscribing it, approximate

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on all sides. Diminution of volume, such as is fre-
quently observed in advanced *cirrhosis*, and much more
rarely in simple atrophy, without other alteration of
texture, cannot be mistaken from these characteristic
signs.   These results of percussion are the more valua-
ble in these cases, because that, in ascites, so frequent
a complication of the lesion before mentioned, the liver
being pushed up and entirely concealed under the false
ribs, has become wholly inaccessible to the touch.

The gall-bladder, which normally escapes detection
by palpation and the use of the pleximeter, may be-
come evident in cases of considerable distention by an
accumulation of bile, serous liquid, or even numerous
biliary concretions.   In percussing transversely, in the
direction of the inferior border of the liver, we may
sometimes discover a more obscure sound, instead of
the clear one of the intestines, which succeeds the he-
patic dulness; and if this particular dulness have its
seat at that point of the abdomen which corresponds
anatomically with the situation of the biliary reservoir,
and if it can be delineated of an oval form, it is more
than probable that it depends on *distention of the
gall-bladder.*

Spleen.—The foregoing considerations are equally
applicable to the spleen. This viscus may be depressed
below its normal position, by a liquid or gaseous effu-
sion into the left pleural cavity, or pushed from below
upwards by ascites, or extensive tympanitis.   In the
first case, palpation is sometimes sufficient to recognise
the position and volume of the spleen; but in the se-

cond, percussion only can furnish certain results, and the changes in position of which we have just spoken, are revealed by analogous displacements of the splenic dulness, whilst in the usual seat of the viscus we discover a resonance foreign to it.

The dulness of the region of the spleen is also susceptible of variation: generally but three inches and a half in extent in the vertical direction, by three inches only in width, (according to the researches of Piorry,) it may diminish or increase to a more or less considerable degree.

Diminution in extent is most frequently caused by the distention of the stomach or intestines by gas, and then sometimes nearly the whole splenic region yields a clear sound. This diminution is, at other times, due to the small size of the spleen; and if we can satisfy ourselves that it is owing neither to tension of the epigastrium or abdomen, nor to exaggerated tympanitic resonance, it may be attributed to *atrophy* of this viscus, such as is frequently met with in individuals who fall into a state of extreme emaciation, from long-continued organic diseases.

But *the increase of volume in the spleen* is an occurrence of much more importance. When the increase is slight, the viscus generally extends beyond the inferior border of the false ribs, and by judging of the volume of this portion of the spleen by touch, we can form an approximate idea of its total dimensions: but percussion alone can give an exact idea of the portion concealed under the ribs, and thus concur in

throwing light upon its real volume. But this is not all: even although hypertrophied, the organ may be pushed up in the same manner as the diaphragm, by gaseous distention of the belly, and, in this case, pleximetry is indispensable to determine its dimensions. The measure of its extent in height is more easy, and generally in hypertrophy, without *organic* lesion, the increase in width and thickness corresponds to that which takes place in a vertical direction. Now, the vertical dulness may rise five, six, or eight inches, and indicate corresponding dimensions in the volume of the spleen. This increase is frequently met with as a sequel to long-continued intermittent fevers; in some rare cases, it may be even more considerable, and this viscus has been seen to extend as high as twelve and fifteen inches, at the same time that it weighed eight, ten, or fifteen pounds, and even more.

Increase in extent of the splenic dulness, so frequently concomitant of hypertrophy of the spleen, may also be met with in other alterations, such as cancers, hydatid cysts, &c. But these latter are very rare, and besides, in them, the shape of the viscus undergoes more or less evident changes. Let us add, in conclusion, that it is not always easy to decide whether a dull sound over the splenic region is really dependent upon the spleen; and that it may be difficult to determine its superior limit in cases of hepatization of the base of the left lung, or pleuritic effusion on the same side, as also, to define accurately its inferior limits in ascites; but percussion

practised with different degrees of force, at the same time changing the position of the patient, will generally enable us to overcome these difficulties.

Stomach.—The clear sound yielded by the stomach varies, even in a healthy individual, in extent and intensity, according as we explore the organ sooner or later after a meal, and in a state of vacuity or plenitude. At all times, the sound is generally moderately tympanitic: it occupies the left portion of the epigastrium, as well as the corresponding hypochondrium, and extends a little towards the more inferior regions of the abdomen.

As a consequence of different pathological conditions, the stomachal sound may become much more intense, assume a very decided tympanitic character, and extending further, may rise in the hypochondriac region as high as the fifth rib, occupy the entire epigastric region, and extend below the umbilicus. We may recognise by these characters, an *enlargement of the stomach* from distention by gas as is frequently observed in cases of narrowing of the pylorus, (hydrogastric.) The sound frequently also assumes a humoric tone which announces the simultaneous presence of liquids and gases collected in great quantity in the cavity of the stomach.

At other times, on the contrary, the stomachal sound is much less decided than in the healthy condition, and confined to much narrower limits, when, for example, the *stomach* is *shrunken*, in consequence of chronic inflammation, or, more particularly, from poisoning by acids.

Sometimes even there is a dull sound perceived over a certain space, principally at the epigastrium and the pyloric region. This dulness often depends upon the presence of the left lobe of a hypertrophied liver or its prolongation in a transverse direction; but it may also be caused by *cancerous degeneration* of the walls of the stomach, or an *accumulation of blood* in its cavity.

In the first case (hypertrophy of the liver) the dulness is permanent, and by deep and forcible percussion we may discover the characteristic sound of the stomach under the more or less thin lamina of the liver which covers it. When the dulness depends upon carcinomatous degeneration, it is usually confined to the pyloric region, where a moveable tumour may be made apparent by palpation, whilst the tympanitic sound again makes its appearance in the left hypochondrium. An accumulation of blood is recognised, on the contrary, by dulness supervening accidentally in the course of a chronic affection of the stomach, and during the simultaneous development of the general symptoms of hemorrhage.

Finally, the stomachal sound, when displaced, may be found more or less removed from the seat occupied by it in the normal condition: thus, the stomach has been seen contained in hernial tumours of the linea alba, and even of the inguinal ring.* The production

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* See case related by Dr. Yvan, of Paris, in the Archives Générales, January, 1830, in which, part of the stomach occupied the sac of a scrotal hernia.— *Tr.*

of a clear sound in them by percussion would reveal the presence of a portion of the digestive tube; and if, after having caused the patient to swallow a quantity of fluid, this resonance is suddenly changed to dulness, it would be incontestable proof that the *stomach itself formed part of the hernia.*

Intestines.—The sound yielded by the abdomen may become *duller* in *all the parts* which correspond with the intestines, or only in a limited region in comparison with these viscera. Dulness extended over the whole intestinal region is often coincident with depression and retraction of the intestine, and then announces a state of vacuity of this tube, and contraction of its walls, as is seen in some cases of cancer of the stomach with constant vomiting.

Dulness confined to a portion of the intestine may be owing to very different pathological conditions. If its appearance in any part of the abdomen coincide with the general symptoms of hemorrhage, it will enable us to recognise the accumulation of a sanguineous liquid, and even cause us to suspect the source of the *enterorrhagia.* If its existence be proved in the right iliac fossa, occupying a definite extent, and there be at the same time prominence or tumefaction of this region, it would be a sign of *intestinal obstruction,* with accumulation of alvine matter and alimentary residua. In the left iliac fossa, it very frequently announces the presence of fæces collected near the end of the large intestine, in consequence of prolonged constipation.

The dulness may also be due to *carcinomatous de-*

generation of the walls of the intestine, or even to *in-testinal invagination.* We are readily led to suspect the existence of one of these two lesions, if the dulness coincide with a tumour situated upon the course of the ilium.

But cancerous tumours of the small intestine are very rare: the degeneration more frequently occupies the colon, and the cancer may then be confounded with accumulation of fæces. Its most usual seat is the left iliac portion; and as it is also the point where fæcal matter most generally collects, there is often in both these morbid conditions a tumour perceptible to the touch, and hence the possibility of an error in diagnosis; this accumulation of stercoral matter may also be mistaken for any other tumour. But let liquids be injected into the colon and percussion again practised after the injection has operated, then if the dulness disappear we will discover that it was produced by a stercoral tumour; and if, on the other hand, it still remain, we ought to suspect the existence of a tumour formed by degeneration of the walls of the intestine, or adhering to its surface.

It will often be useful to associate these injections with the use of the pleximeter, not only to determine the presence and position of the large intestine, but also to diagnosticate many of its diseases: they serve, in fact, according to Piorry, to define more accurately the existence and seat of *narrowing of the colon,* accessible neither to the finger nor to a bougie introduced into the rectum. If, for example, a small in-

jection is given, the liquid cannot pass beyond the narrowing; and when, afterwards, percussion gives a dull sound below a certain point, and a clear one above it, there is reason to admit that the narrowing is seated at the point where resonance gives place to dulness.

The intestinal sound often becomes more intense, and entirely tympanitic. This modification is rarely confined to a small part of the abdomen, but generally occupies a large proportion of it. It announces the presence of a considerable quantity of gas in the belly. In an immense majority of cases, the elastic fluids are enclosed in the intestine, (intestinal pneumatosis,) and occasionally they are contained in the cavity of the peritoneum itself. In either case, the tympanitic sound is general; for the intestines, when inflated with gas, have a tendency to fill the cavity of the abdomen, which in *peritoneal pneumatosis* is always distended throughout, unless there be morbid adhesions. However, in meteorism, it is rare that the tympanitic sound is of the same intensity in all points; it is frequently more decided in the region of the colon, and the windings of the intestine may be traced through the abdominal walls. In true tympanites, on the contrary, the intestines are pushed up posteriorly, and the resonance is more uniform. Another characteristic will serve to distinguish these two species of pneumatosis: in intestinal meteorism the liver is forced up towards the thoracic cavity, but it rests in contact with the walls of the hypochondrium, where its presence is evidenced by the dulness peculiar to it, whilst, in tympa-

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nites, it is displaced at the same time upwards and backwards, and the exaggerated resonance extends even to the hepatic region.

If the tympanitic resonance of the intestines assumes the humoric character, it is an indication of the simultaneous presence of gas and fluids. Sometimes these fluids are enclosed in two contiguous cavities, and the humoric sound is then only obtained in the limits separating the dull sound of the one, and the clear sound of the other; if the liquid be confined to one viscus, as when the bladder is distended by urine and in contact with the intestines inflated with gas, it remains permanent in the same region; on the contrary, it is subject to displacement if the liquid itself may be displaced, as is observed in ascites, where the effusion obeys the laws of gravity.

Sometimes the liquids and gas are enclosed in the same cavity, and this occurs most generally in the intestine, as has been seen in the right iliac region in the majority of typhoid fevers; in this last case, also, sudden pressure upon this point causes us to hear and feel a gurgling which is not obtained when the two fluids occupy different cavities.

Finally, the intestinal, as well as the gastric sound, may be found in a point more or less remote from the seat to which they belong. These displacements are witnessed particularly in cases of *herniæ* of the umbilical and inguinal region; and percussion, by revealing the resonance of these tumours, proves that they are formed by a portion of the digestive tube. When

the hernia is not strangulated, we may sometimes satisfy ourselves, what portion of the intestine is displaced, by means of an injection by the anus. If the clear sound be permanent, it is a sign that the small intestine is contained in the hernial sac; if the resonance be changed to dulness, it is a proof that it is produced by displacement of the large intestine.

The Kidney.—The kidney is so deeply seated behind the anterior abdominal wall, and placed posteriorly and laterally beneath so thick a muscular layer, that it is very difficult to determine by percussion its exact seat and precise dimensions. Pleximetry only serves to throw light upon the diagnosis of some of its diseases, such as extensive hypertrophies, tuberculous or cancerous degenerations, multiple cysts, hydronephroses, or other alterations, with decided *increase in volume :* in these cases we perceive a greater and more extensive dulness in the flank and loins of the corresponding side. We have seen a case of this kind in which the dulness rose as high as the sixth rib, and descended as far as the iliac crest, and the kidney was found to have degenerated into an encephaloid mass of from twelve to fifteen inches in length.

Percussion may also cause us to suspect either *absence* or *atrophy* of the kidney, or *displacement* of this viscus, if the region where it is generally found yield less dulness and less resistance to the finger. We may know that it is due to the first of these alterations, if we cannot succeed in discovering any unusual tumour in the abdomen, and to the second, if we

can establish the existence of a tumour having the shape of the kidney, either in any point of the abdominal cavity, or especially near the sacro-vertebral angle, where we have several times found the organ of the urinary secretion.

The Bladder.—The bladder, situated low down in the lesser pelvis, is, when empty, separated from the anterior abdominal wall by the lower convolution of the digestive tube, and percussion of the hypogastrium yields only the clear sound of the intestine. It is otherwise when it is distended with urine: its fundus, then ascending in the abdomen, passes beyond the pubis; its anterior face is in contact with the abdominal wall at a varying height, and its presence is recognised by a dull sound, circumscribed above by a curved line, with the convexity uppermost. This phenomenon, which is very easily established, becomes a valuable sign of *retention of urine;* and the extent of the dulness, whose superior limit rises sometimes as high as the umbilicus, affords us a measurement of the quantity of liquid accumulated in the bladder. This dulness suffices to distinguish retention of urine from suppression, and micturitions arising from over-distention, from the dribbling of incontinence. It is equally sufficient to establish the diagnosis between tumefaction of the belly, due to the accumulation of urine in the bladder, and the development of the hypogastrium in cases of uterine pneumatosis. The distinction will be more difficult between retention of urine and other anatomical conditions, which also

give rise to a dull sound, such as cysts, or other solid
tumours of the hypogastrium, and particularly preg-
nancy and dropsy of the uterus. But, in the first
case, percussion at the superior limit of the dulness
will yield a humoric sound, which will not exist in
dropsy of the womb, or in pregnancy, and which,
still more evidently, will be wanting when the deve-
lopment of the uterus is dependent upon other patho-
logical conditions, as solid tumours, for instance. Be-
sides, under all these circumstances, the resistance to
the finger will be greater than in the case of urinary
tumour; and if cysts with very thin walls do not
offer this resistance, and we can find a humoric sound
at their limits, we must remember that they rarely
occupy a median position, and that they scarcely ever
have the symmetrical form of the distended bladder.

As to ascites, which also gives rise to dulness in
the hypogastric region, we cannot mistake it, from
the very arrangement that the dull sound assumes,
being circumscribed by a curved line with its con-
cavity uppermost, and particularly by this marked
characteristic, that it changes its position with that of
the body.

The Uterus.—In the normal condition, and when it
is empty, the womb, buried in the lower part of the
hypogastrium, is inaccessible to touch, and completely
concealed from percussion. But when it is normally
developed by the presence of an embryo, or patholo-
gically by different morbid conditions, pleximetry will
furnish valuable results for diagnosis.

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In *pregnancy*, percussion practised with care, will give (according to Piorry) a dull sound from the end of the second month, which is an indication of the development of the uterus. If this phenomenon is perceived before we can recognise the enlargement of the organ, by palpation at the hypogastrium, by ballottement, by touch, or by auscultation of the characteristic sounds of pregnancy, it will be a valuable sign at this period, which will add greatly to the probability of gestation. But this result, at so early a period, can only be obtained in exceptional cases. At a more advanced stage, in proportion as the uterus, increasing in size, passes the pubis and rises into the abdomen, we can easily establish by means of percussion at the hypogastrium, a dulness, circumscribed by a curved line convex superiorly, whose extent, form, and situation are in relation with the volume, configuration, and symmetrical or inclined position of the uterus. The characters of this dulness, no doubt, establish a strong presumption in favour of the existence of pregnancy; but it does not give any certainty, and will be insufficient to decide whether the development of the uterus is physiological or pathological, whether it is due to gestation, dropsy of the uterine cavity, or to any other morbid product, as a mole, fibrous body, &c. The presumption of pregnancy will be greater, if the dulness advances with the regularity and progress proper to this condition; but we are not always able to establish this ascent of dulness, and the semeiotic results of pleximetry are inferior to those furnished by auscultation at this period. But,

according to Piorry, percussion may facilitate the diagnosis, and enable us to recognise pregnancy by several other characters of the dulness, such as its greater intensity with more marked resistance to the finger in certain points which correspond with the fœtus, and its diminished intensity with an obscure sense of fluctuation in the intermediate points; finally, its displacement by changes in positions of the fœtus, characters which fail in the pathological conditions already cited.

Pleximetry, in yielding similar results, is particularly useful in establishing the existence of pregnancy, in cases where we are unable to discover either the sound of the fœtal heart, or the placental souffle by auscultation; and it may also, to a certain extent, aid in determining the position of the fœtus.

In the morbid condition it is likewise by a dull sound that lesions of the uterus nearly always manifest themselves, whatever be their seat. Thus, in cases of dropsy, slight internal hæmorrhages, or fibrous bodies of great volume, percussion yields a dulness whose extent gives the degree of development of the womb or the dimensions of the tumour. Some peculiar characteristics may serve, in addition, to give precision to the diagnosis: thus, in *dropsy* or in *internal hemorrhage*, the dull sound is equal throughout, and without much resistance to the finger, and the space occupied by it is regularly ovoid, like the uterus itself, whilst in the case of *fibrous bodies*, there is not the same uniform intensity throughout: some parts of the organ offer a greater or less resistance to the finger, and the shape of the space

occupied by the dulness, is, in addition, very irregularly rounded.

It is in very rare circumstances that the uterus can yield a *tympanitic* sound; a slight accumulation of gas in its cavity is alone capable of producing this phenomena. This fact, however, has been sometimes observed, and *uterine tympanitis* will be probable, if we can establish at the hypogastrium an oval swelling, yielding a clear sound, circumscribed in every direction, and unchanging in its position.

In regard to the *uterine appendages*, the most common lesions, which are capable of modifying the resonance of the lower part of the abdomen, are cysts of the *ovary* and *Fallopian tubes*, giving rise to a dull sound ordinarily witnessed on one or the other side of the hypogastrium, and which rarely assume a symmetrical position in the median region. The dulness will be more marked, and accompanied by a greater resistance, in proportion as the walls of these sacs are thicker, and the contents more consistent. The extent of this dulness, concurrently with palpation, will give the approximate measure of the size of the tumours. As long as they are only of moderate dimensions, the cysts of the ovary and Fallopian tube cannot be confounded with ascites; but when they fill the whole abdominal cavity, the case is altered. We shall give hereafter the differential characteristics of the dull sound in both these diseases.

Peritoneum and abdomen generally.—After having studied particularly the alterations of resonance proper to the principal viscera, it only remains now to describe

those which may occupy the whole extent of this cavity, and those which, although localized, may be found indifferently in various regions of the abdomen.

The whole belly may yield a much more obscure sound on percussion, in cases of *serous infiltration of the abdominal walls*, and in those of *obesity* with thickening of the sub-cutaneous adipous layer, with fatty infiltration of the folds of the peritoneum, and of the deep-seated cellular tissue.

Sometimes, also, the whole region which corresponds to the intestine, yields an obscure sound in *chronic peritonitis*, when there exist false membranes, thickened and infiltrated with tubercles, with or without tubercular degeneration of the mesenteric ganglia, and in these cases, palpation serves to perfect the indications of pleximetry.

At other times, an abnormal dulness may be present at one point or other of the belly. It may be due either to a tumour developed in one of the organs of which we have already spoken, or it may depend upon a circumscribed puriform collection in the serous cavity, upon a hydatid cyst, a cancer of the epiploon, or an abscess of the extra-peritoneal cellular tissue, as is frequently seen in the iliac fossa and in the lesser pelvis.

The degree and extent of the dulness will commonly give the measurement of the density and size of these *solid or liquid tumours*, and its seat may sometimes enable us to discover that of the lesion; but, in general, the results of percussion are not sufficient for dia-

gnosis, and in order to arrive at an accurate knowledge of the alterations, we must add to the pleximetric indications, the result furnished by palpation of the abdomen, and rectal or vaginal touch, and take into account equally the presence and progress of the concomitant symptoms.

The diagnosis will be possible with the aid of percussion alone, when the dulness, instead of being confined to a circumscribed region of the abdomen, occupies the whole inferior portion, and particularly when, at the same time, it is susceptible of displacement, by changing the position of the patient. These characteristics are sufficient to enable us to recognise *ascites*. The presence of a liquid effusion into the peritoneum, will be still more certain, if we obtain a humoric sound in percussing upon the limits of the dulness, or if an evident fluctuation is perceived.

There are some cases where the dulness occupies the whole, or almost the whole, of the abdomen, which presents at the same time a very large size. We may then diagnosticate almost with certainty the existence of ascites, or extensive ovarian dropsy. The distinction will be established by the following characteristics: in *encysted dropsy*, the dulness occupies the most prominent region of the belly, whilst the clear sound is found at the sides, where the intestines are pushed back by the tumour. In *ascites*, on the contrary, the dull sound occupies all the inferior portions, whilst in the sub-umbilical region the presence of the intestines, which are pushed up towards the epigastrium and float

upon the surface of the liquid, give rise to a tympanitic sound which contrasts with the dulness of the rest of the abdomen, from which it is separated by a curved line, concave superiorly. We may add, that the fluctuation is much more decided in ascites than in encysted dropsy of the ovary.

Besides the various modifications of resonance here described, there is one which is most frequently met with in the abdomen, but which may be found in very different regions of the body and extremities. It is a peculiar sound, or rather, a *mixed* phenomenon obtained by percussion, and resulting from the association of a kind of humoric sound with a vibratory thrill perceived by the hand, and designated by the name of the *hydatic sound or vibration.* This phenomenon, of which we may have a very accurate idea by shaking an acephalocyst in the palm of the hand, is actually dependent upon the existence of hydatids, and is produced by the oscillations of the vesicles in the pouch which encloses them. This thrill is not present in every hydatiferous tumour: its absence, therefore, does not prove that a spherical tumour in the region of the liver is not an acephalocystic cyst; but its presence constitutes a pathognomonic sign of this variety of disease.

Percussion of the head, neck, spine, and extremities.

Can we class among the facts of pleximetry the imaginary sound of a broken vessel that the cranium

yields on percussion in cases of fracture, the peculiar
sound rendered by a carious tooth when struck with a
stylet, the dulness with fluctuation present in articu-
lations which are the seat of hydarthrosis, &c.?

Percussion may have more real and useful applica-
tions in some cases of fistulous abscess containing gas
or air; sometimes, also, it will serve as a differential
diagnosis between anasarca and emphysema of the cel-
lular tissue, by manifesting in the first disease a nota-
ble dulness, and in the second, resonance accompanied
by dry crepitation under pressure of the finger.

Piorry has also proposed to percuss over the verte-
bral column, or the spinal regions, in order to recog-
nise either aneurisms of the descending aorta, altera-
tions or change in size of the vertebræ, or abscesses
developed in their neighbourhood, consecutively to
caries.   In all these cases there is a dull sound yielded
on percussion, and the extent and form of this dulness
indicate the size and shape of the alterations.

Finally, Mr. Stokes, of Dublin, has advanced the
opinion, that percussion may not be without advantage
in the diagnosis of diseases of the larynx.*   But
Piorry, before him, had already published all his views
upon this subject.†   "Percussion of the larynx or the
trachea can only be performed mediately.   In order
to practise it, we must fix the trachea and larynx, by
the assistance of the pleximeter, firmly held upon these

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* A Treatise on the Diagnosis and Treatment of Diseases of
the Chest.   1837.

† Traité de Diagnostic, t. i., 412.

tubes. In the normal condition, the finger discovers elasticity, and the ear resonance over the points which correspond to these organs. There are very few pathological conditions in which it will be otherwise, unless there should be a tumour on the neck surrounding the trachea and larynx; then we may make use of percussion to determine their seat. The presence of liquids in the ventricles of the larynx, followed by the penetration of air into the neighbouring cellular tissue, may be suspected, if percussion upon the neck discovers an unusual resonance in connexion with emphysema. In cases where a soft and depressible tumour is situated upon the larynx, we may judge of the depth at which it is seated, by that at which we obtain resonance, by pressing upon the tumour with the pleximeter, and then percussing."

There are some circumstances in which we can use to advantage *percussion and auscultation combined.* Laennec has proposed the simultaneous employment of these two methods of examinations in certain cases of pneumothorax;[*] it is generally resorted to, in order to manifest and more clearly demonstrate the hydatic sound. Cammann and Clark have gone further,[†] and

[*] " We may," says he, " estimate the extent and space occupied by the air, by ausculting and percussing, at the same time in different points; we then hear a resonance similar to that of an empty cask, mixed occasionally with tinkling." Tom. i., p. 139.

[†] A new mode of ascertaining the dimensions, form, and condition of internal organs by percussion and auscultation. July,

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attempted to generalize this mixed method; they have
applied it to the exploration of the viscera of the chest
and abdomen, and they affirm, that it is possible thus to
bound in every direction the solid organs which are in
contact with each other, as the heart and liver, or
which are placed, the one before the other as the lung
and the heart, or even, again, those which are sur-
rounded by different media, as the abdominal viscera
in the ascitic liquid.* Any attempt at progress in
semeiology ought not to be rejected, and on this ground,
the researches of these New York physicians deserve
the attention of practitioners; but we must remark, that
this mixed method has the great disadvantage of de-
manding the simultaneous co-operation of two ob-
servers, and we are of the opinion, that the results of

1840. Copied into the Archives, Gén. de Méd. 1841. Vol. x.,
p. 225.

* It appears that these gentlemen proceed in the following
manner: One of the observers applies his ear upon the extremity
of a solid cylinder (of wood, cut in the direction of the fibres, six
inches in length, by ten or twelve lines in diameter,) the other
end of which rests on an intercostal space. The other observer
percusses according to the usual method, at one or two inches
from the point with which the instrument is in contact. The
sounds thus obtained are perfectly transmitted by the solid stem,
and they are perceived with extremely marked differences, in pro-
portion to the differences of structure and material disposition of
the organs examined. We regret that we have not been able to
procure the original article of Messrs. Cammann and Clark,
and consequently, that we cannot, as we would desire, repeat
their experiments, and judge of their value by a full acquaintance
with the subject.

pleximetry and auscultation, as usually practised, are sufficient for all exigencies of diagnosis.

[The paper of Drs. Cammann and Clark being too long for insertion entire, the principles, object, and mode of application of their method have alone been condensed from their original account in the New York Journal of Medicine and Surgery, for July, 1840, as follows:

"Place one extremity of a cylinder of wood cut in the direction of its fibres, evenly on the body, over the region of the liver, or on the anterior surface of the tibia, and apply the ear to the other. Now, let a person percuss in the usual way on the same region, or along the bone, within one or two inches of the point on which the cylinder rests; the sound communicated to the ear is intense, and even painful, very far exceeding in energy the same vibrations intrusted to the free air. Let the observer compare the bone and the liver, when their constituent particles are thus thrown into sounding vibrations, he will find, what from ordinary percussion he would have little reason to expect, that they greatly differ, both in degree of resonance and in tone. The latter exceeds in sonorousness, the former sounds on a higher note. Corresponding differences will be found to exist if fluid confined in the chest or abdomen, be compared with one or other of these parts; and in general, it may be assumed, that whenever the media compared differ in mechanical and chemical structure, there will be differences in these two respects; differences most easily recognised by comparison, yet in many cases, susceptible of separate recognition.

But associated with these, are differences in other qualities and accidents of sound, equally, or even more

marked. The observer, suppose, practises first over the heart, listening and percussing on the same region. With each blow of percussion, the ear receives a sudden, clear, intense sound of high tone, attended with a degree of impulse even painful, appearing to be immediately under the instrument, or produced within it; of short duration, and ending with some degree of abruptness. Now, find the longest diameter of the heart in contact with the walls of the chest, it may be three inches, listen at one extremity and percuss at the other. The sound is the same in character, and it has lost little of its energy. Percuss at the point where the lung begins to overlay the heart; the sound is instantly modified and mixed, yet its cardiac type is still preserved. Recede still farther with percussion, moving by short steps toward the body of the lung; at a certain point the sound suddenly changes. It loses its intensity and high tone, is no longer impulsive, but is grave and distant, much more distinctly heard by the open ear, than by that applied to the instrument. Again, let the observer in like manner explore the hepatic region. Within short distances, the sound is sudden, clear, intense, and immediately under the instrument as before; yet it is less intense, less acute, and more prolonged; it is even semi-reverberant. As he increases the distance between the points of auscultation and percussion, the sound diminishes more rapidly than over the heart, though it is not entirely lost till percussion passes off from the organ, on to another medium. By this mode of exploration, the heart and liver become distinguishable through a class of signs, which, judging even from the analogous consistency of these organs, would not be supposed to exist."

By this method of percussion it is proposed,

" 1st. To measure the heart in all but its antero-

posterior diameters, under most, perhaps all circumstances of health and disease, with hardly less exactness than we should be able to do if the organ were exposed before us.

"We have been able to trace the outlines of the heart, when the whole organ has been covered with healthy lung; when the lung over it and around it has been hepatized from inflammation, or consolidated by tubercles; when with such tuberculous consolidation, there has been remarkable thickening of the pleuritic membrane over the precordial region; when pleuritic effusion on either side has, to ordinary percussion, blended the cardiac and pulmonary portions of the chest into one region of unbroken dulness; when extreme effusion on the left side has crowded the heart wholly to the right of the median line upon the convex surface of the liver, so as to produce uninterrupted dulness, from the entire left side, across the anterior right half of the chest, to the hepatic region; when there has been empyema and pneumothorax of the left side; when there has been atrophy of the heart; when there has been hypertrophy and dilatation, each separately, and both combined; when there has been preternatural softening and fatty degeneration; when there has been pericarditis with adhesions;* when the stomach has been filled with aliment, or the abdomen with fluid.

"2d. To trace the outlines of the liver with much greater certainty than by ordinary percussion, in circumstances of health; and to circumscribe it in many

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* Auscultatory percussion promises to distinguish with facility serous effusion into the pericardium from any form of disease of the heart itself. But it is remarkable that more than three months' search among 1700 Dispensary patients, and even a great number of Hospital sick and Almshouse invalids, which we were permitted to examine by the politeness of Dr. Vaché, should not have furnished us one case of hydro-pericardium.   •

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conditions of disease in which ordinary percussion is not applicable.

We are able to follow the liver nearly an inch higher on the chest, where its convex surface gradually retreats from the thoracic walls, than is usual in ordinary percussion; to trace its left lobe, and its lower border to the extreme limits of their thin edge; to distinguish the liver from the heart when these organs come in contact, whether the stomach be full or empty; to limit the upper surface of the liver when the right lung is hepatized; or when there is effusion in the right pleura; to limit the lower thin edge in the serous effusion of ascites; to mark the line of separation between the liver and spleen when the latter is enlarged, and the two organs are in contact.

"3d. To ascertain the dimensions of the spleen in circumstances that baffle ordinary percussion.

"We have traced the outlines of the enlarged spleen in the midst of abdominal serous effusion,—distinguished it from the liver when it has approached, or been in contact with that organ: and we shall probably be able to limit it in all cases, except when abdominal effusion or a fold of intestine passes between it and the abdominal walls; and even in these cases, if there be a single point of contact on which to rest the stethoscope.

"4th. To mark the superior, inferior, and external limits of the kidneys. Ascites presents no obstacle to the measurement of these organs; and from enlarged spleen the left is easily distinguished. . . . .

"We pass now to the comparative study of the sounds furnished by certain parts and products of the body, with the view of establishing them as typesounds, with which to associate or contrast others. We may assume for this purpose, those furnished by water and by bone as the extremes in the scale, and

call them, for convenience, *aqueous* and *osseous*. Of
these the osseous, as has been already more than
hinted, is the most highly characterized, and most
easily distinguished from others; in pitch it is highest;
in energy it is intense, striking on the ear with even
painful force; in quantity full and loud; conducted to
the greatest distance; somewhat prolonged and slightly
ringing; immediate, clear, and impulsive.* A watery
fluid within the abdominal, but especially within the
thoracic walls, seems to transmit through those walls,
very imperfectly its own peculiar sound. Though a
good conductor itself, it communicates sonorous pulses
to a more solid body with great loss. Hence, notwith-
standing it possesses appreciable positive qualities, it is
on negative properties that we, to some extent, rest
our judgment regarding it. In the abdomen, within
short distances this sound is quick, immediate, acute, of
moderate intensity, abrupt, inelastic, and much less
conductible and impulsive than the preceding. In the
chest its characters are with difficulty distinguished.
Indeed, the sounds of fluid, and of healthy lung, exa-

* For the sake of conciseness and perspicuity, we will use the
following terms in describing sounds only in the senses here an-
nexed to them. *Immediate*, to signify that the sound comes to
the ear as if applied directly to the extremity of the stethoscope;
opposed to distant. *Abrupt*, (abrumpo, to break off,) to refer to
the termination only; opposed to prolonged, reverberant, &c.
Distant. It often happens that a sound is heard by the open ear
alone, or by that applied to the stethoscope, only when the other
is closed by the finger. No impulse comes with it, and it is
plainly produced in some body foreign to that on which we are
listening; opposed to immediate, intense, impulsive, &c. *Quick*,
to signify the same as when used with reference to the pulse,
describing the time occupied by the sound in developing itself.
Acute, to refer to the place a sound has in the diatonic scale; op-
posed to grave. *Impulsive*, to describe the shock or jar, of which
the external ear mainly takes cognizance, as possessing the sense
of touch. The shock or impulse accompanying sound so limited,
is not in all cases proportioned to loudness, or intensity.

mined through the thoracic walls, so nearly resemble each other, that it is probable neither of them is capable of communicating, in any considerable degree their vibrations to these walls, but that it is chiefly the parietal sound which the ear receives.   Hence the ease of distinguishing from fluid in the chest, a solid or consolidated organ—hence also the superiority of ordinary percussion in the examination of the rarer media.   The hepatic and cardiac sounds, in most of their qualities, fall between those just described.   They have already been referred to at some length, and will consequently now require but a word.   *The cardiac* approaches nearest the osseous; it has acuteness, clearness, and conductibility in the tissue producing it, but in a less degree than that of bone; it is quick; immediate; intense; rather painfully impulsive; and gives, at the circumference of the organ particularly, a sort of muffled metallic ring.   *The hepatic,* compared with the cardiac, is more grave, more continuous, less freely conducted by the organ in which it is produced; but is clear, intense, immediate and impulsive.   With one or other of these sounds, it may be convenient to compare all other sounds that we may have occasion to study.   It will be seen that they have many properties in common, while each possesses characteristic qualities.   Water in the abdominal cavities is distinguished by quickness, abruptness, and a sort of leaden inelasticity—bone by its high pitch, clearness, and great conductibility—liver by its graver note, diminished conducting power, and semi-reverberency; while the heart falls between the last two, and is recognised more by the degree, than by the distinctive nature, of its qualities.   The sounds of healthy lung, of tympanitis, and of pneumo-thorax, differ indeed widely from any here described, but we leave them to ordinary percussion, since their vibrations are much more fully conducted by air than by a solid medium.

"It has been already sufficiently explained that the leading peculiarity of our method consists in the manner of conducting to the ear the sounds elicited by percussion of the solids of the body. The instrument we have found most convenient, and most generally applicable, is a solid cylinder of cedar, shaped in the direction of the woody fibres, 6 inches in length, and 10 or 12 lines in diameter; furnished with an ear-piece which will allow nearly the whole cylinder to pass through it, so that it may apply directly to the tube of the ear without change of medium. To avoid as much as possible the sound of the thoracic walls, as is desirable in some cases, this instrument has been modified, by reducing it at its objective extremity, to a truncated wedge, leaving the other extremity as before. This is applied between the ribs so as not to touch them, and at the same time approach somewhat nearer the object under examination. The common stethoscope may be used, but it conducts less perfectly than the solid instrument, and for obvious reasons. The question whether the bones around the ear conduct, or assist in conducting the sonorous pulses to the auditory nerve, however important in other relations, need not here be examined. It is sufficient for our purpose, if experiment prove that these instruments give us the fullest perception of the sounds we wish to examine.

"Regarding percussion, we find a pleximeter in the examination of thoracic and abdominal organs almost indispensable. An impulse is to be sent through an external covering composed of separate layers, to a viscus beneath. This impulse loses little by the interposition of light solids, but much if loose or badly approximated tissues intervene. It is then desirable that the tissues of the thoracic or abdominal walls be consolidated as much as is practicable. This indication

is conveniently fulfilled by moderate pressure with a finger of the left hand, while this same finger serves sufficiently well as a pleximeter. The same consolidation and full contact is still more important at the point where the sonorous vibrations are to be received upon the stethoscope, but this is easily effected, and almost without the design of the listener, by the pressure necessary to apply the aural extremity of the stethoscope firmly to the ear."]—*Tr.*

The following remarks in relation to this method of exploration will show the results attainable by it.*

"During the last eight years, we have been in the habit of constantly resorting to this method, in a large hospital practice, with the most satisfactory results; estimating the size of the heart, even when covered with the borders of an emphysematous lung; determining the line of separation between two solid organs, pressing against one another—as, for instance, a scirrhous tumour of the stomach pressing against an enlarged liver;—a large cancerous kidney adherent to, and continuous with the lower edge of the liver, so that from the palpitation of the abdomen, the tumour had been taken for one occupying the liver, but where the error was at once detected, by using this mode of percussion. The most frequent and useful application of this mode of exploration is in compound fractures of the bones, where applying the stethoscope on one part of the bone, and percussing along its shaft, the exact point and direction of the fracture at once becomes evident the moment the finger reaches the seat of the lesion of continuity. This is done without inflicting pain on the patient, by handling the limb to ascertain the presence of crepitation, or subjecting him to the

* Review of Stillé's Elements of General Pathology, in American Journal of Medical Sciences, for October, 1848.

chances of increased inflammation, from laceration of the parts by the spiculæ of bones. A little practice will soon enable any one, whose ear has been already educated to appreciate the phenomena of auscultation, to avail himself of this valuable addition to our means of diagnosis, which seems not to be recognised on the other side of the Atlantic, and to be but little esteemed here because it has not a foreign descent to give it some *prestige*."—(*Tr*.)

THE END.